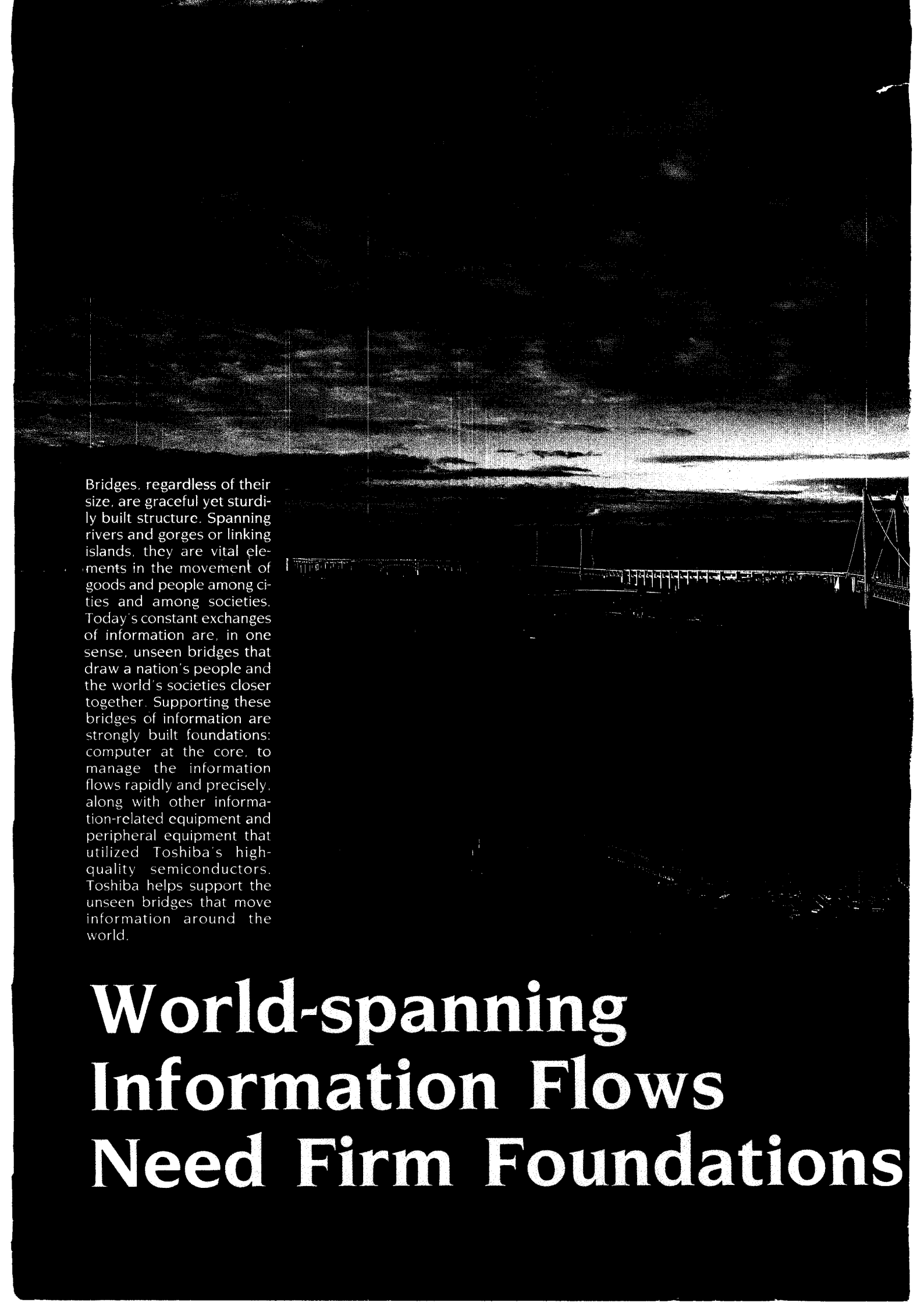


TOSHIBA

System of Catalog Of Semiconductors

For
Peripheral Equipment

A dark, grainy photograph of a bridge spanning a body of water under a cloudy sky. The bridge is a long, multi-span structure with a prominent tower on the right side. The water is dark and reflects the light from the sky. The sky is filled with heavy, dark clouds, with a brighter area near the horizon where the sun or moon might be setting or rising. The overall mood is somber and dramatic.

Bridges, regardless of their size, are graceful yet sturdily built structure. Spanning rivers and gorges or linking islands, they are vital elements in the movement of goods and people among cities and among societies. Today's constant exchanges of information are, in one sense, unseen bridges that draw a nation's people and the world's societies closer together. Supporting these bridges of information are strongly built foundations: computer at the core, to manage the information flows rapidly and precisely, along with other information-related equipment and peripheral equipment that utilized Toshiba's high-quality semiconductors. Toshiba helps support the unseen bridges that move information around the world.

World-spanning Information Flows Need Firm Foundations



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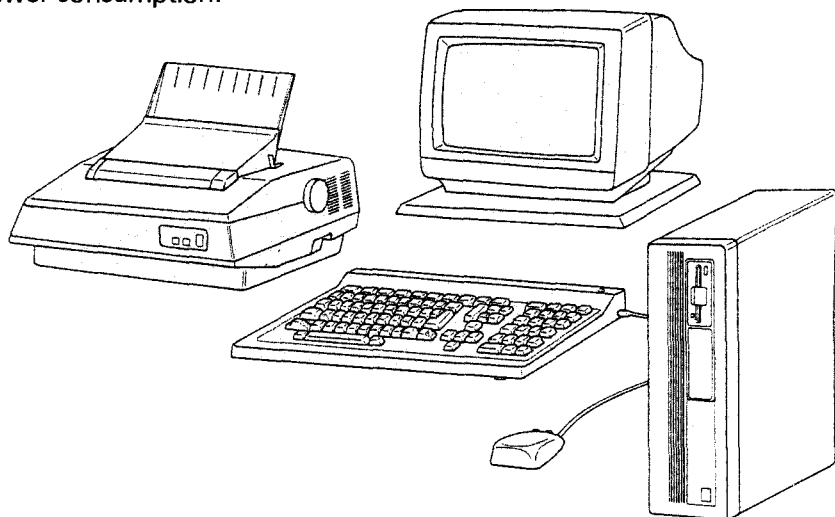
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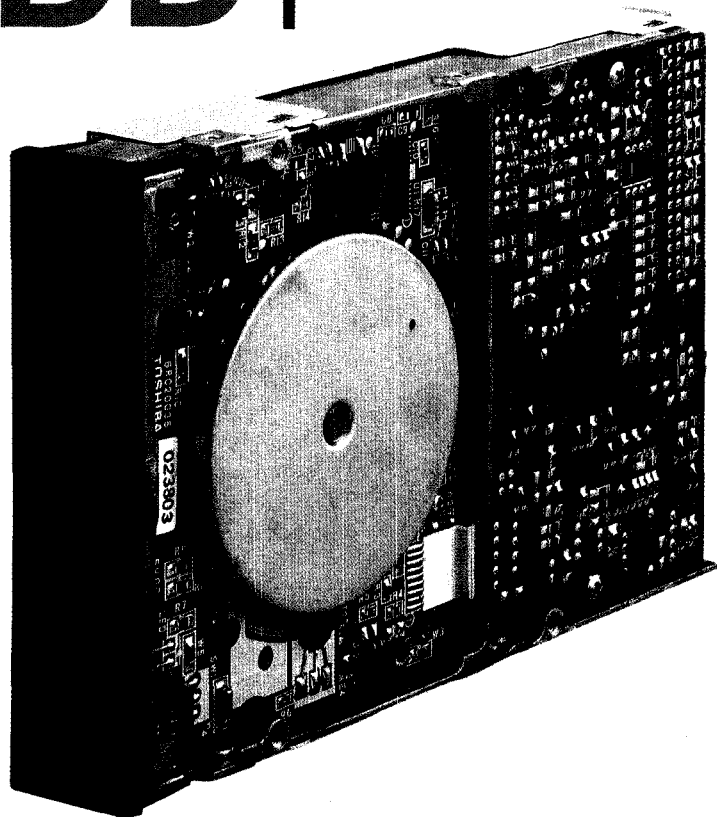
XIII . ASIC - Application Specific IC.....55

Semiconductors for Peripheral Equipment

In the highly-sophisticated information-oriented society, the performance of peripheral equipment for personal computers is rapidly improving while costs are dropping. The motive forces for these changes are the wide use of the group of ICs called ASICs for entire systems, and the improvements they make in overall performance, including greater integration of semiconductors, faster operating speeds, and lower power consumption.



FDD | Floppy Disk Drive



Floppy disk drives can be used to record and playback data using magnetic heads in the disks with magnetic materials coated on a thin layer of plastic film as do tape recorders.

They differ from tape recorders in that the tracks used to record and playback data are concentric with the center of the disk. This makes it possible to read or write data in any sequence. FDDs contain mechanisms for positioning the heads, and to hold and rotate the disks.

HDD | Hard Disk Drive

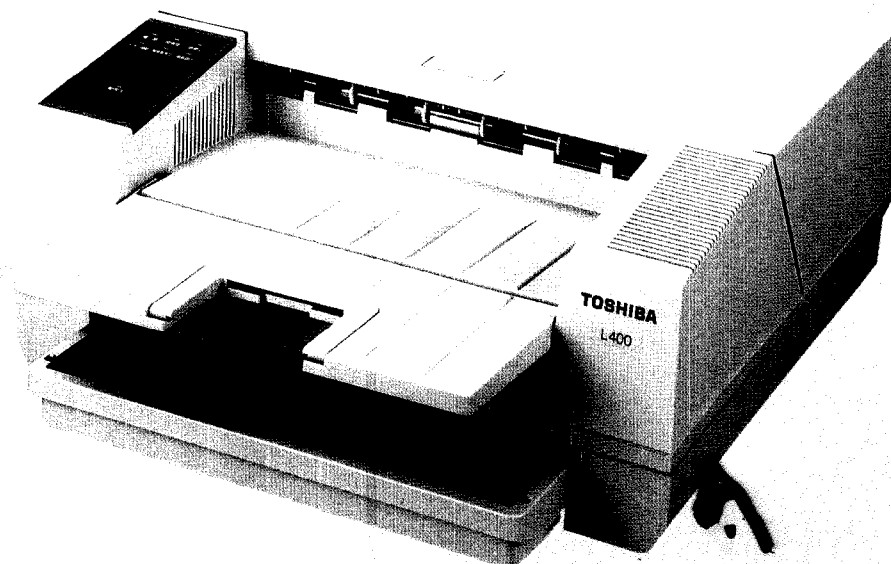


Hard disk drives are structurally very similar to the FDDs. The main difference is that HDDs use mirror-polished aluminum disks sputtered or plated with magnetic material as the recording medium instead of the soft material used for FDDs.

Hard disks also rotate at high speeds of around 3,000 rpm. Because of that, data transfer speeds are about 10 to 20 times faster with hard disks than with FDDs. There are also 10 times more tracks because of the higher machine accuracy, so disk capacity is also several tens of times greater.

These devices themselves are precision machinery. The R/W (Read/Write) heads float several microns above the recording surface using the principles of fluid dynamics and the units are sealed to prevent the entry of dust.

PRT | Printer



The transition from type printers to dot matrix printers has meant a tremendous increase in the use of electronics. Today, high-speed, high-resolution, high-quality laser beam printers that can respond to complex image processing and also to character information including kanji (Chinese characters) are in great demand as output devices. The technologies incorporated in laser beam printers start with electrophotography and form-feed technology as a base. To this is added scanner technology that integrates a highly accurate rotating multiple-mirror surface — achieved by precision mirror-polishing processes — with a Hall-element motor. Laser beam printer features include a Japanese outline font with two typefaces; capability of printing sheets up to A3 size; a high printing speed of 7 to 10 sheets per minute; graphics resolution of 400 dots per inch; and very low printing noise. It is indeed a high-quality copying/printing device and delivers superb image quality.

Function Block Diagrams

Peripheral Equipment Interfaces

■ CPU Core Section

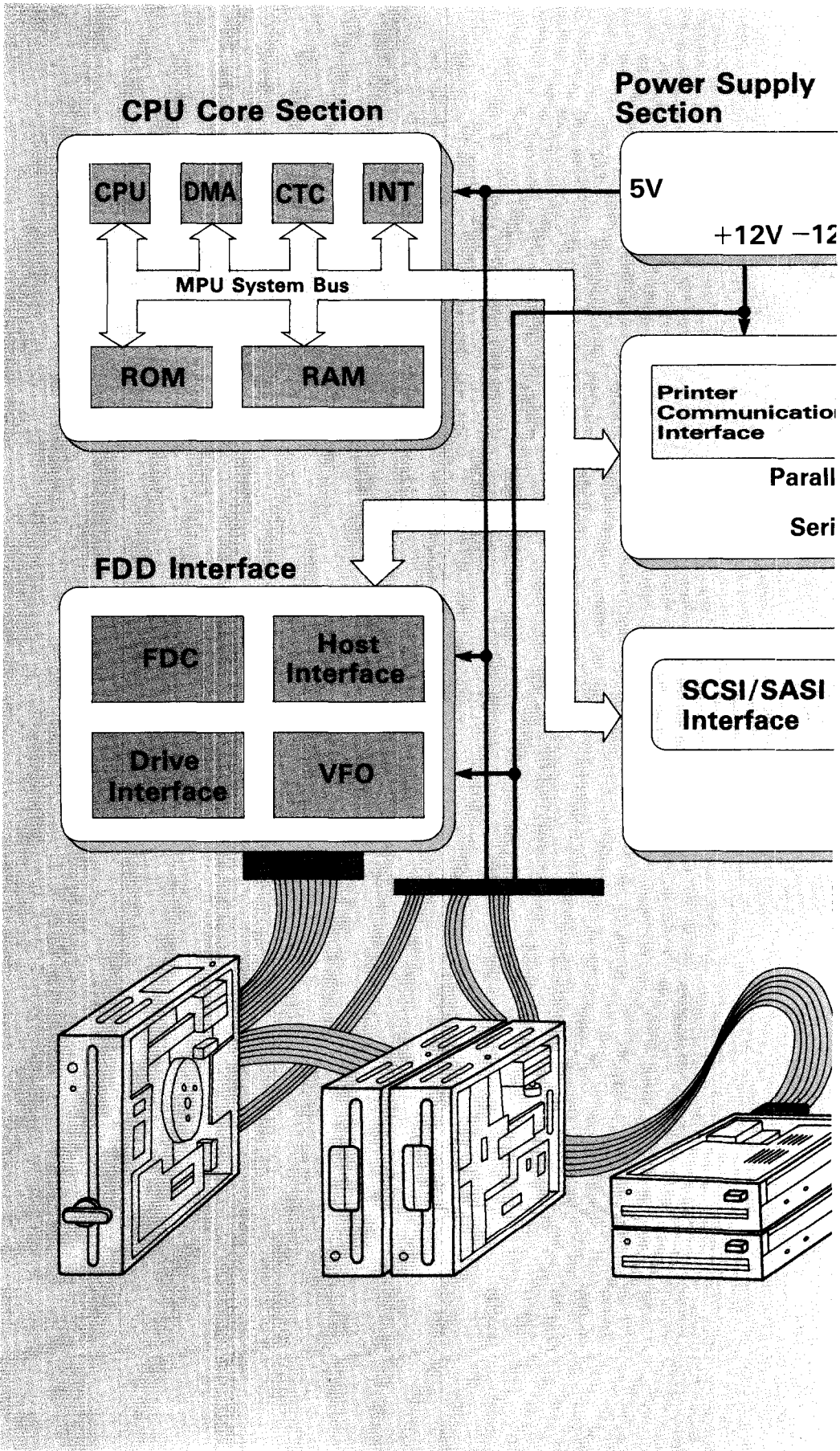
The data are transferred between the core sections of computer CPUs and peripheral equipment. The data from the core section are transferred using an 8-bit or 16-bit parallel data bus. Each type of peripheral equipment, however, has its own particular standard data interface, so "handshaking" is necessary to get the various interfaces to work together.

■ FDD Interfaces

FDD data interfaces are of the serial type and use a signal format called MFM for magnetic recording. Other signals are also provided for positioning the heads and detecting the drive status.

These and other types of control are performed by an IC called the Floppy Disk Controller (FDC). Also, VFO is always necessary. The role of the VFO is to eliminate the read signal components caused by variations in motor speed so that correct data can be sent to the FDC.

There are 8-inch, 5.25-inch and 3.5-inch floppy disk drives but the interfaces are all basically the same. Unformatted capacities range from 2M-byte to 1.6M-byte, 1M-byte and 0.5M-byte; and the data transfer speeds (500Kbps, 250Kbps), disk speeds (360rpm, 300rpm) and number of disk surfaces used (double-sided, single-sided) differ.



■ Printer Interfaces

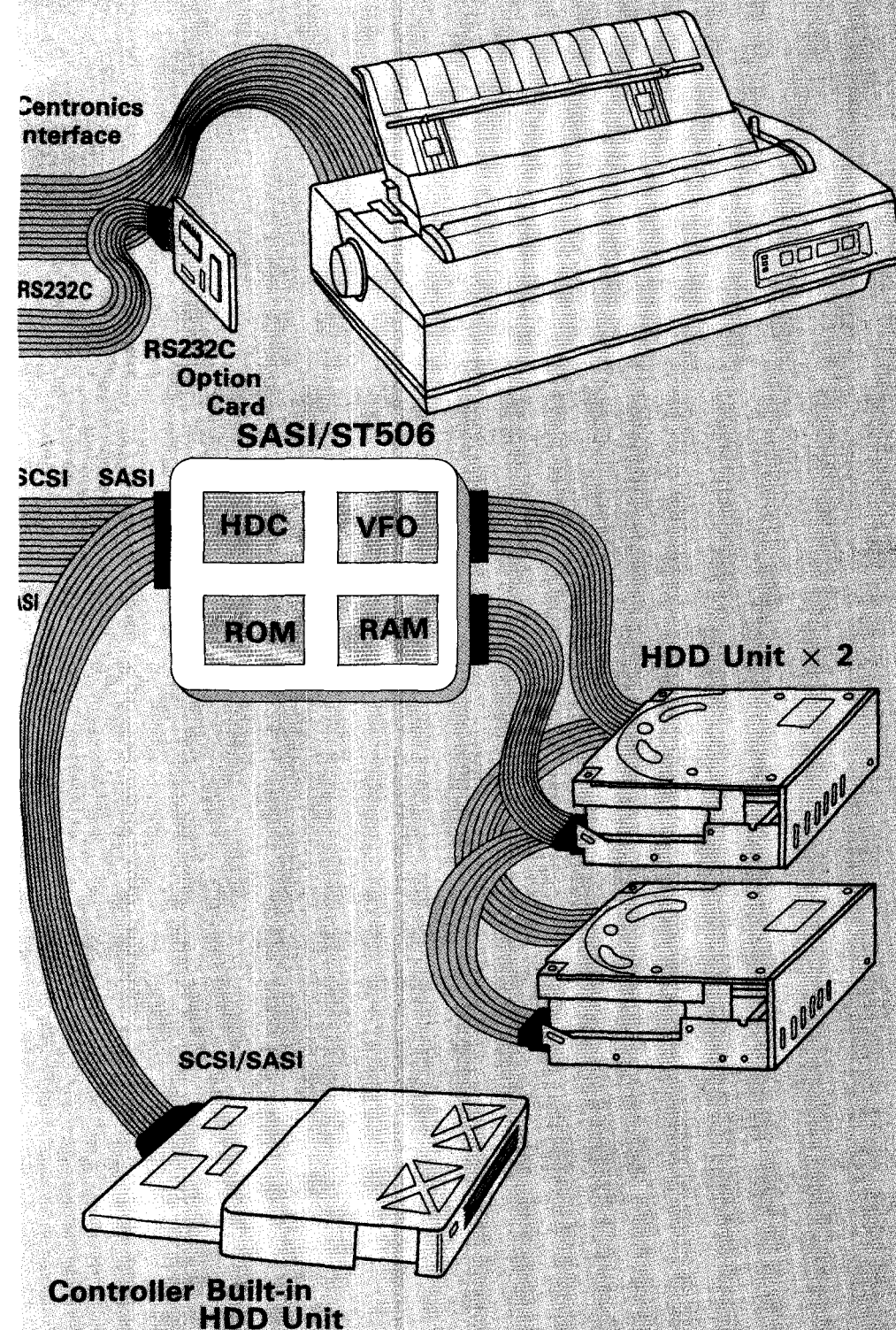
The main printer interface is the parallel type called the Centronics interface. When two printers are being connected to a host computer that has only one Centronics interface, however, another interface must be used for the second printer. The RS232C serial port used for communications can be used in such cases. For that reason, most printers are made available with an optional RS232C type interface.

■ HDD Interfaces

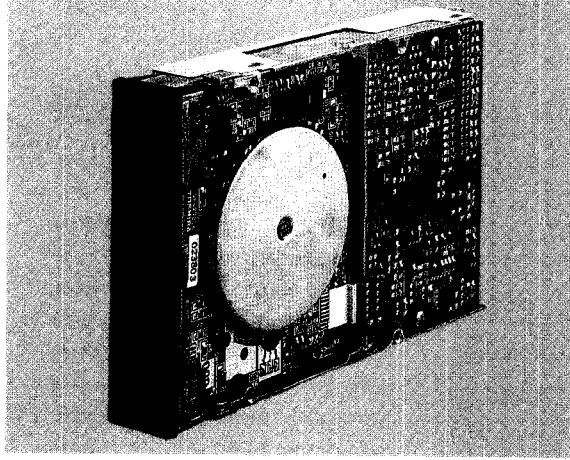
Since hard disks have much higher data transfer rates than FDDs, they require more advanced interfaces. Basic data conversion is handled by the Hard Disk Controller (HDC), as the FDC does for FDDs. The main interfaces are those between the HDC and CPU, and between the disk drive and HDC.

The former includes standard interfaces such as Small Computer System Interface (SCSI) and Shugart Anschutz System Interface (SASI) and IBM-PC interfaces.

The latter include the ST506 type, similar to those used for FDDs and the improved Enhanced Small Device Interface (ESDI) type for hard disk drives for large computers. Some new drives have the HDC built into their drives.



FDD/FDC

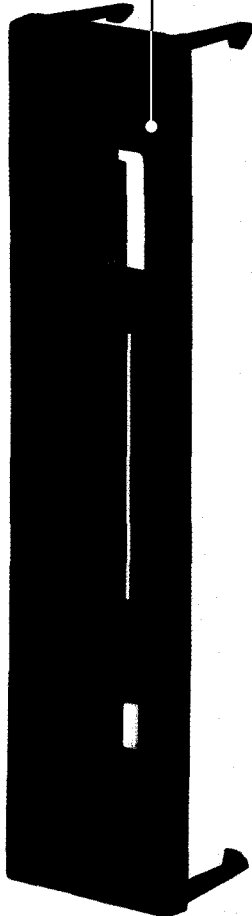


As general external memory devices, FDDs are coming to be standard equipment in personal computers, workstations and low-price MSXs and personal word processors. For this reason, every year brings demands for FDDs at still lower prices.

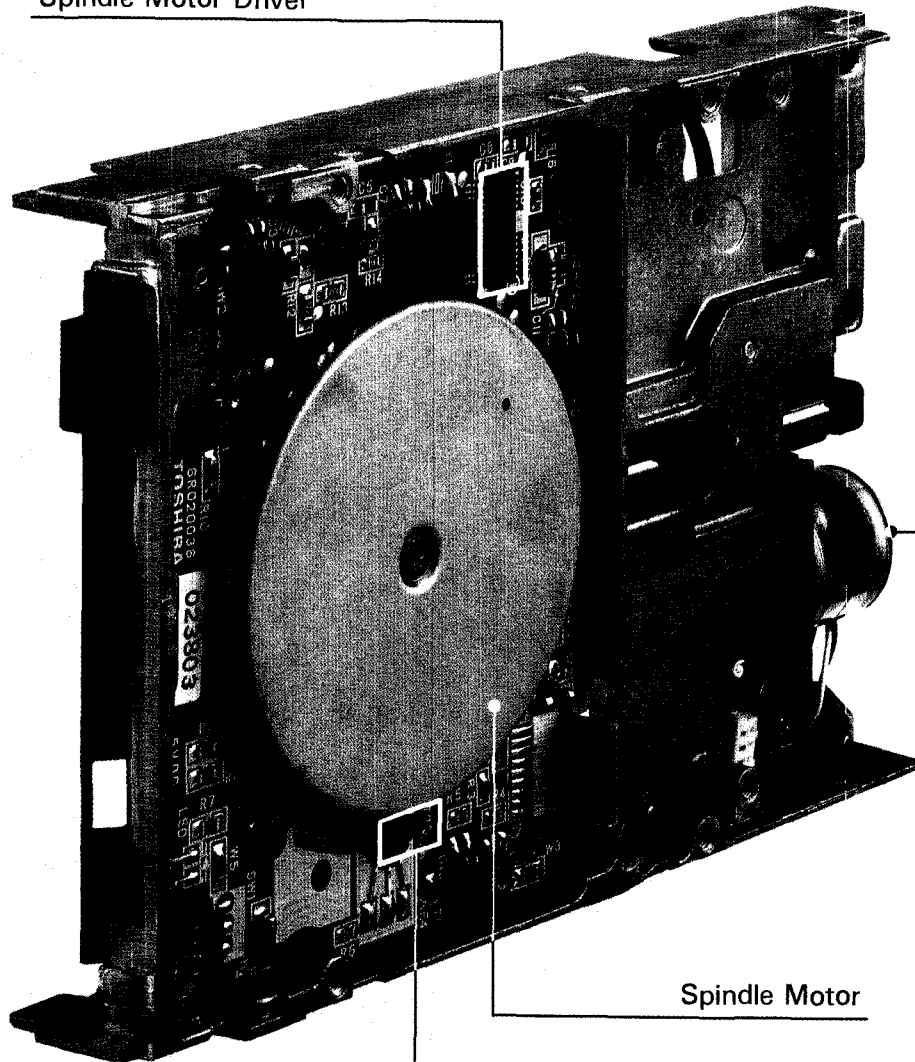
To meet diverse needs for compactness, low price and versatile specifications, Toshiba provides a full lineup of IC/LSIs for FDDs, such as various signals, R/W ICs, stepping-motor drivers, spindle-motor drivers and FDMCs (floppy disk mechanism controllers).

Moreover, for use as control circuit boards, FDCs (floppy disk controllers) that integrate VFOs on a single chip and adapters that respond to host-side bus are available for a range of applications.

Front Bezel

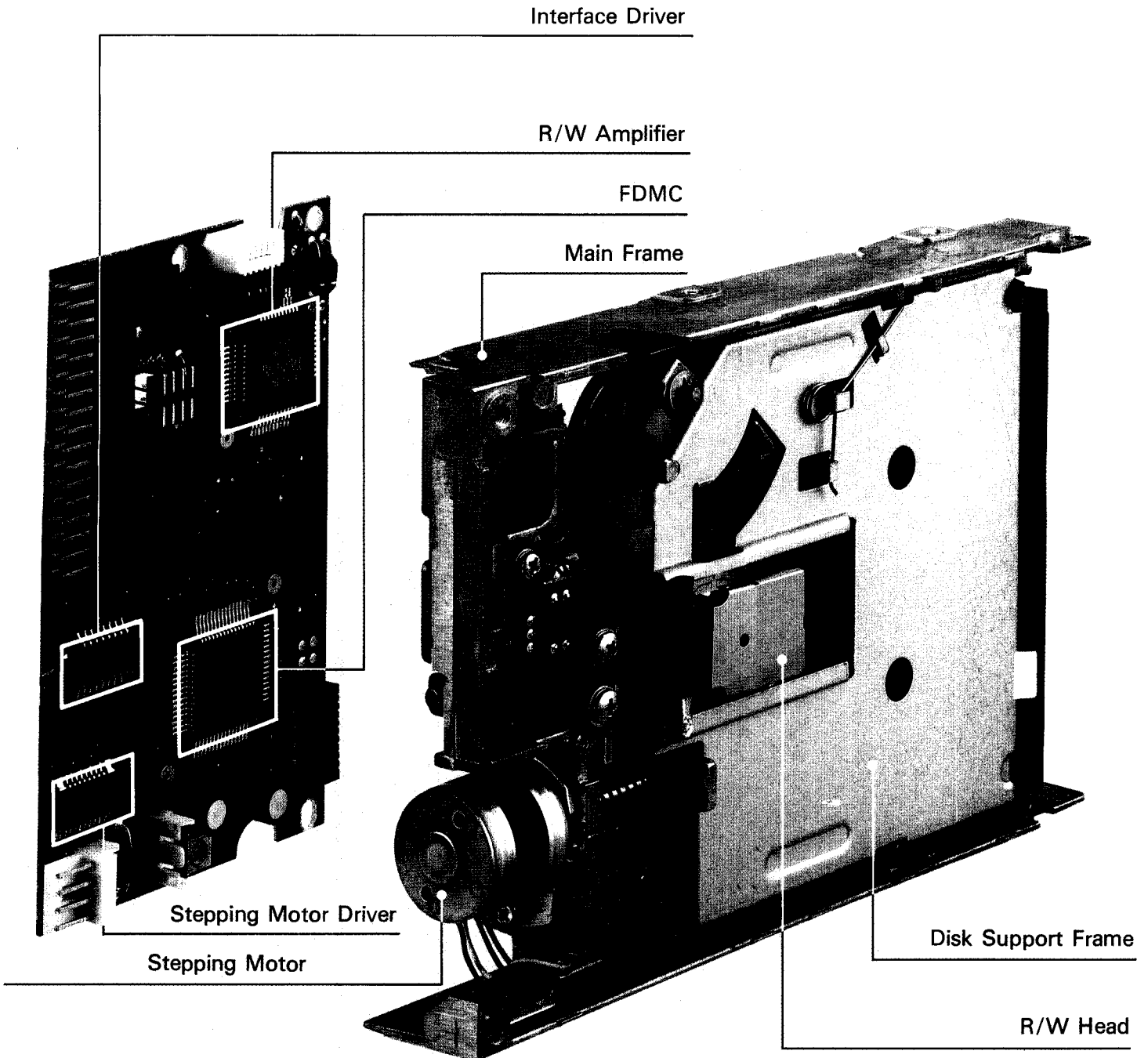
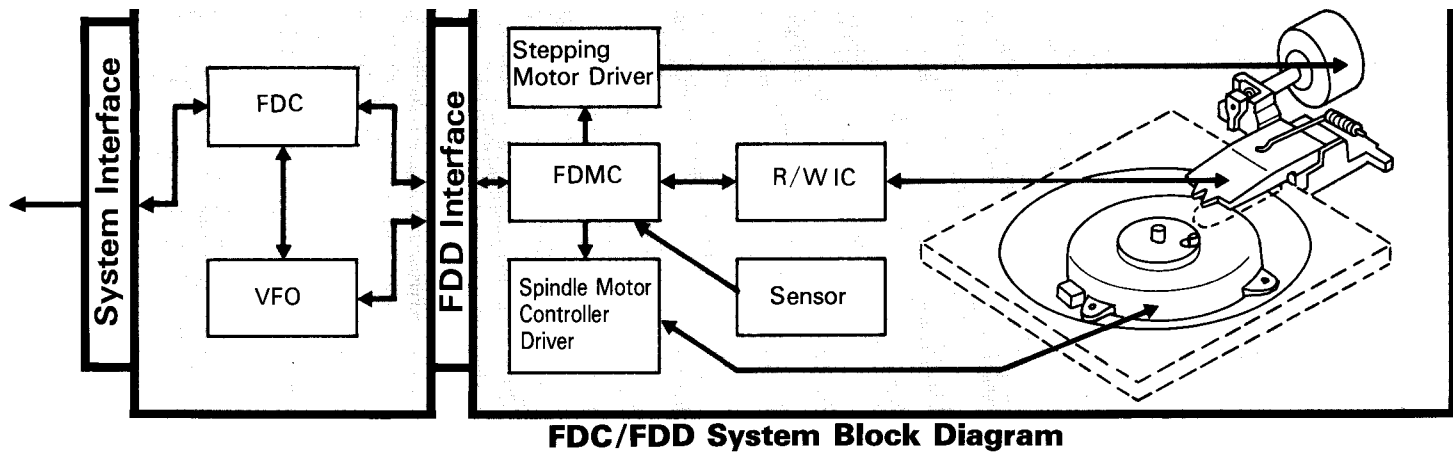


Spindle Motor Driver



Spindle Motor

Hall Sensor



HDD/HDC

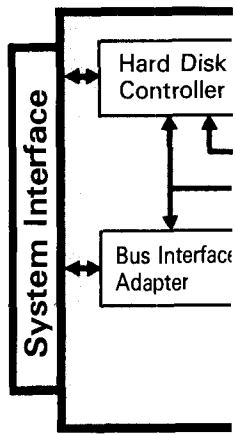


Today, as a result of the development of high-performance CPUs, large amounts of data can be processed at high speed, and high-performance HDDs are becoming the indispensable devices.

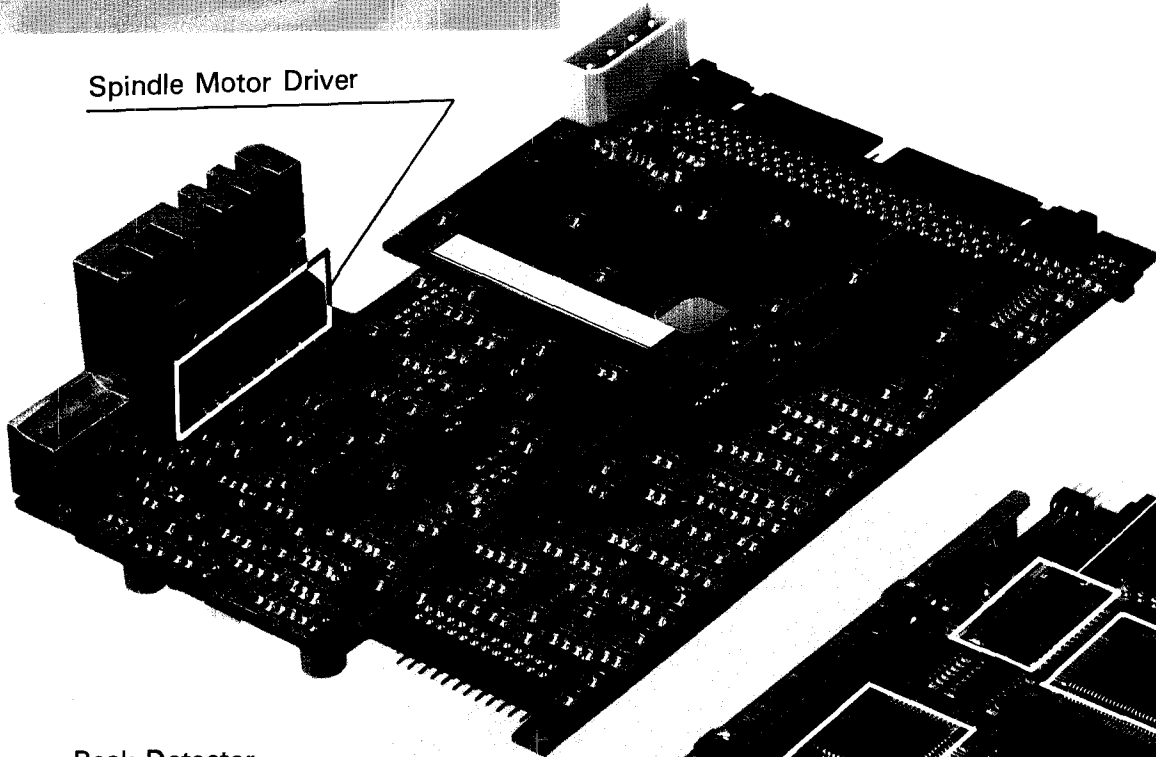
The HDD driver side includes from the control CPUs to the analog signal ICs (R/W ICs, peak detectors), servo ICs which are necessary for high-speed access, and the motor controllers/drivers.

HDD PCB, the high-performance controller with control CPU built in as a core, provides a non-adjustable data separator and bus adapters to meet with the host side buses, and meets various applications as an HDC board chip set.

HDC



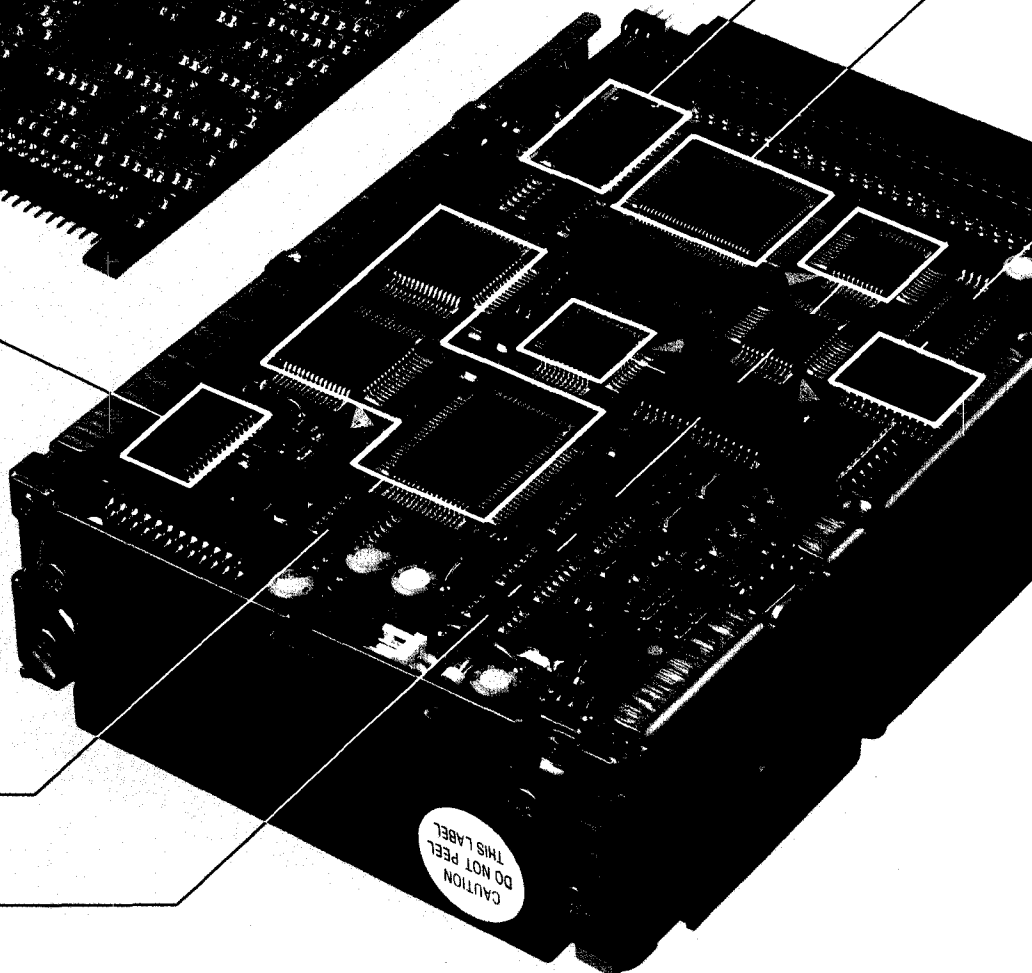
Spindle Motor Driver



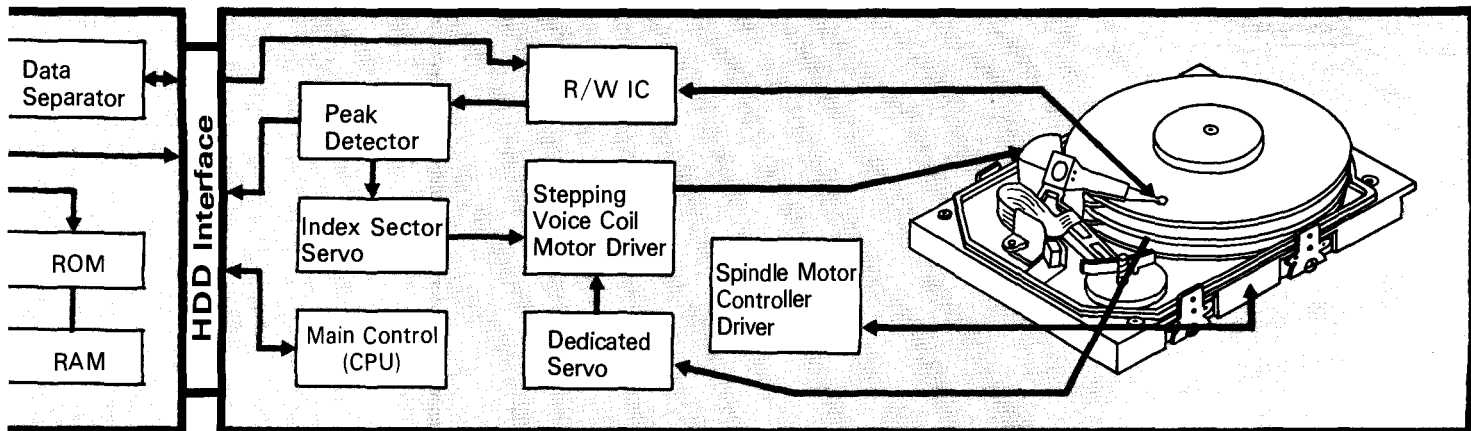
Peak Detector

Control Circuit

CPU



HDD



Buffer Memory

Hard Disk Controller

R/W Head

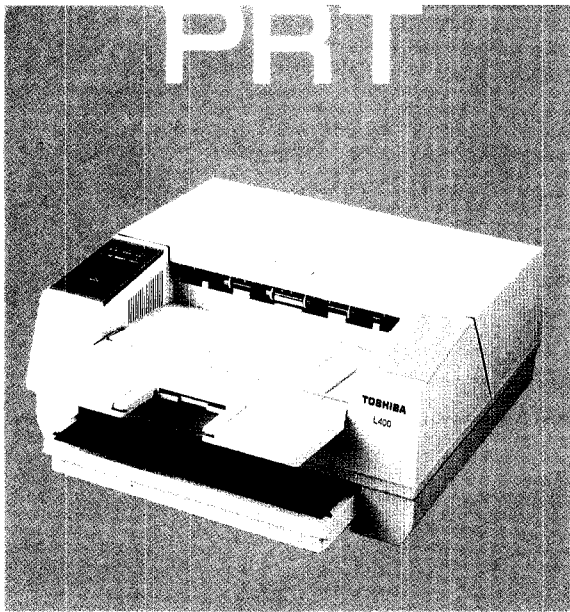
Working Area

Voice Coil Motor

R/W Amplifier

Platter
(Magnetic Disk Plate)

PRT



A printer-dedicated controller (T7835), printer interface LSIs (CPC), head drivers, motor drivers, RAMs and ROMs are all supported within a system. For laser beam printers, which are increasingly in demand, the TMP68301 dedicated controller and a wide variety of MPUs are provided in the lineup. Also, depending on the application, such as in ASICs, there is a wide selection of suitable GAs (gate arrays), SCs (standard cells) and SI (superintegration) technology for custom hardware.

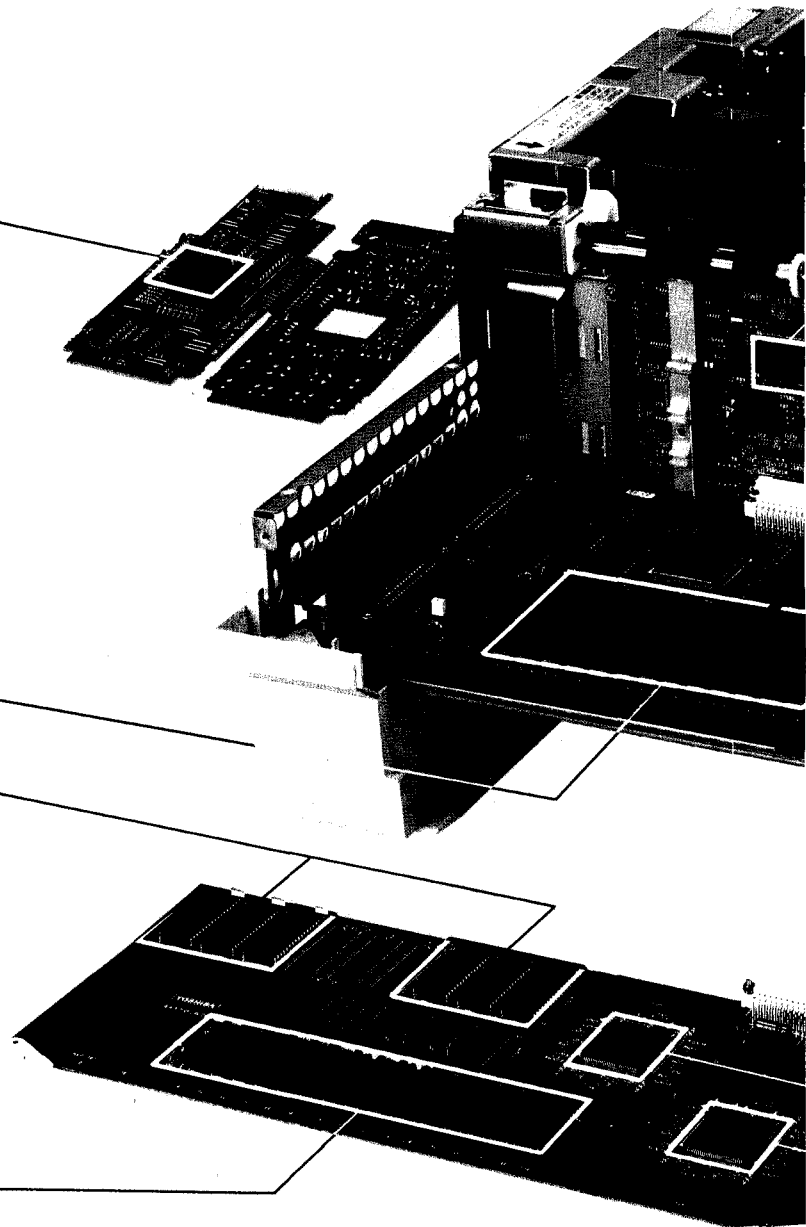
System Bus

Display Segment

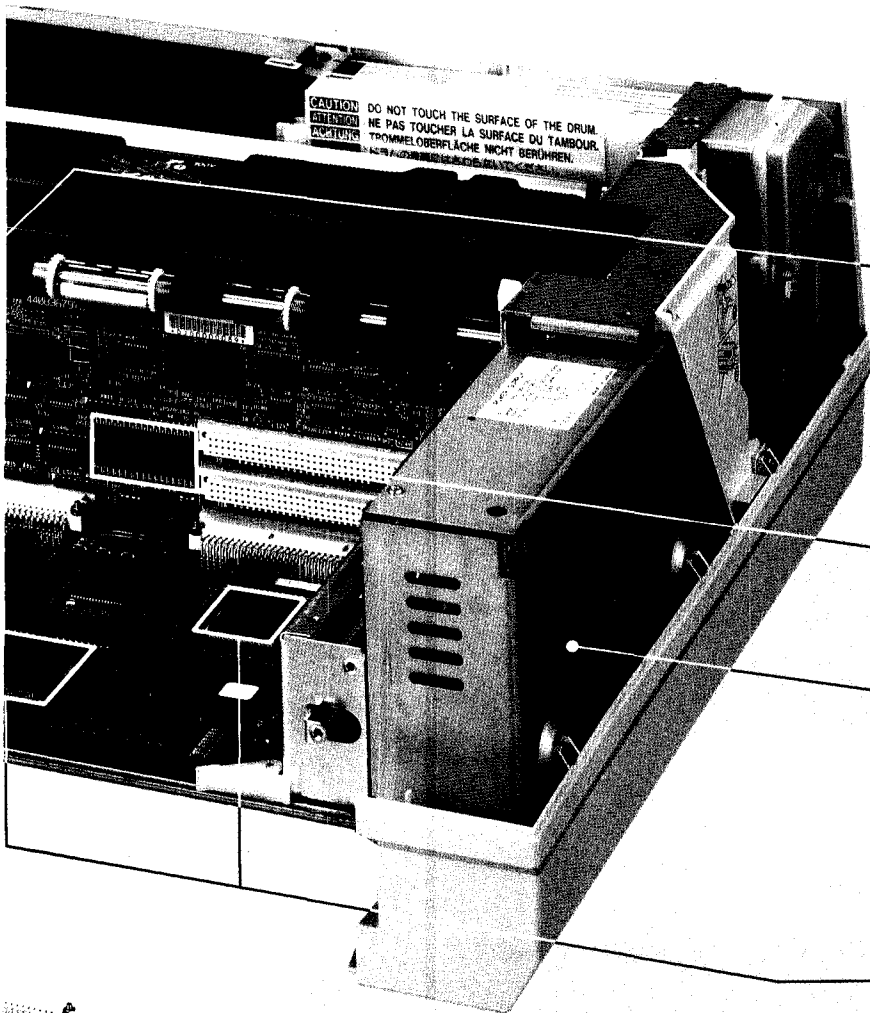
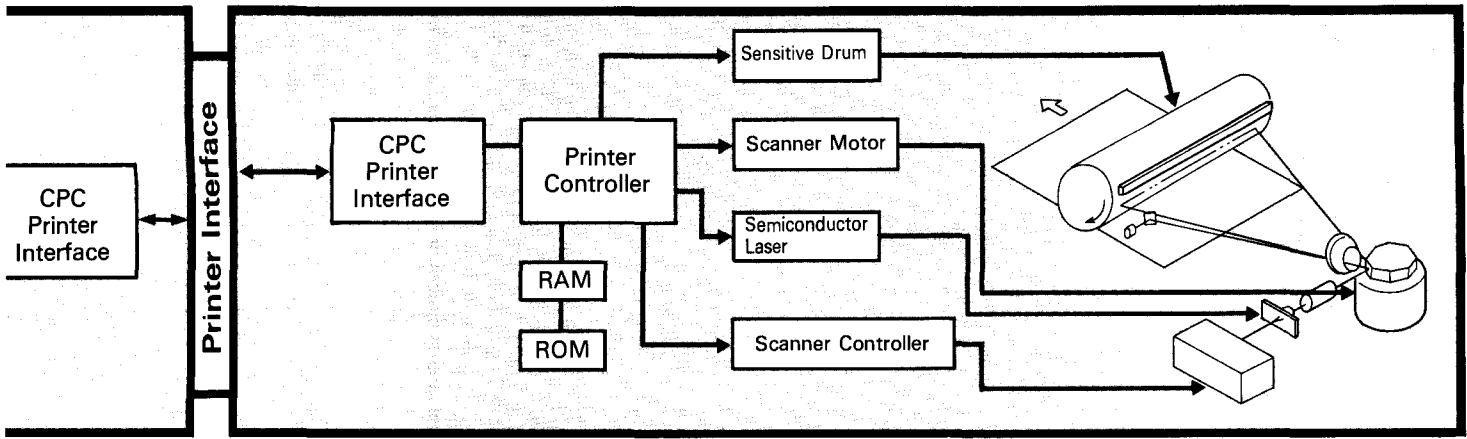
Buffer RAM

Character ROM

Buffer RAM



PRT



I/O Control SI

CPU

Power Supply

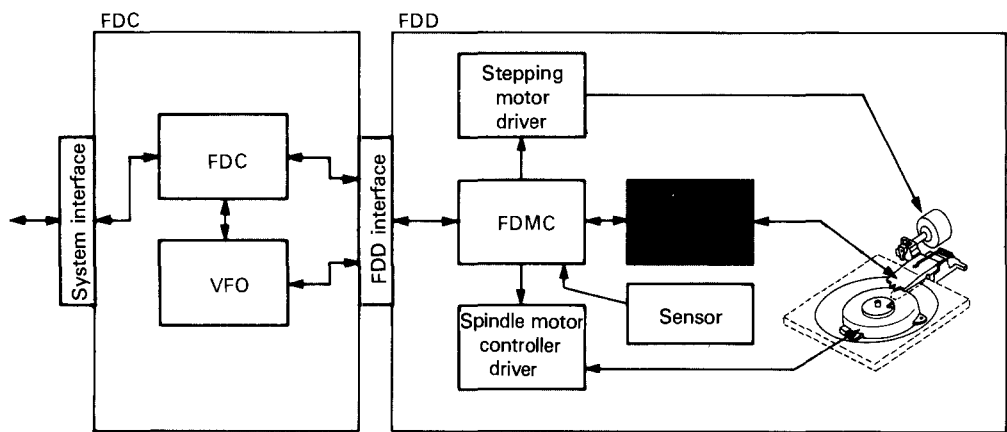
Control G.A.

Memory Control G.A.

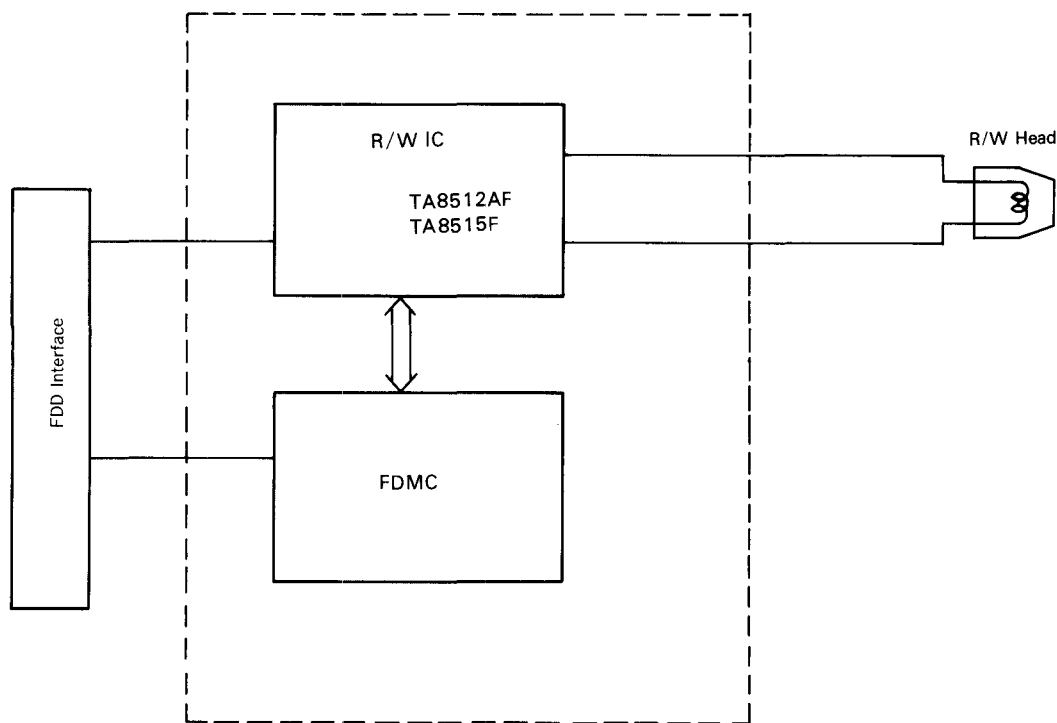
I. Signal Processing Section

FDD Signal Processing LSI

FDC/FDD System Block Diagram



Read/Write (R/W) IC Block Diagram

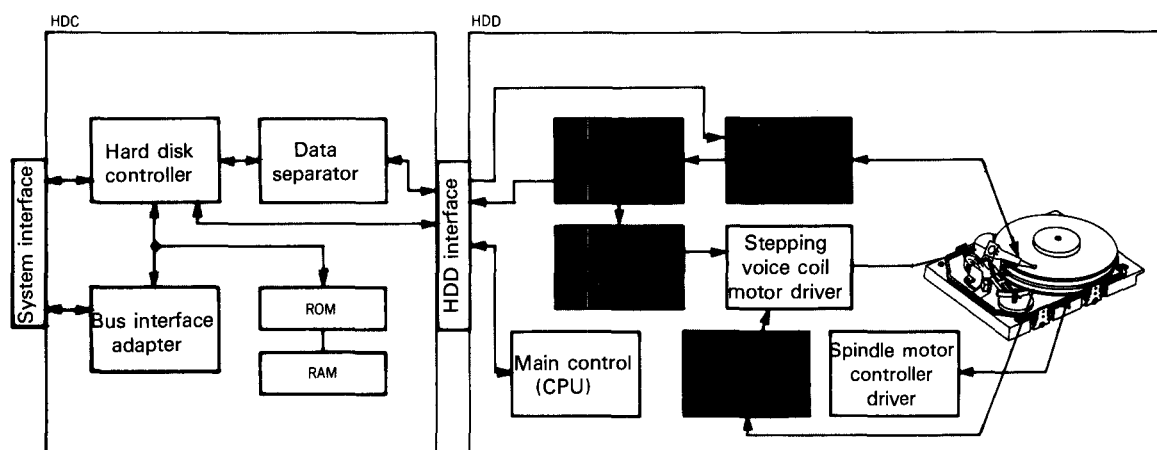


R/W IC, Single-chip IC (R/W + FDMC) Product Chart

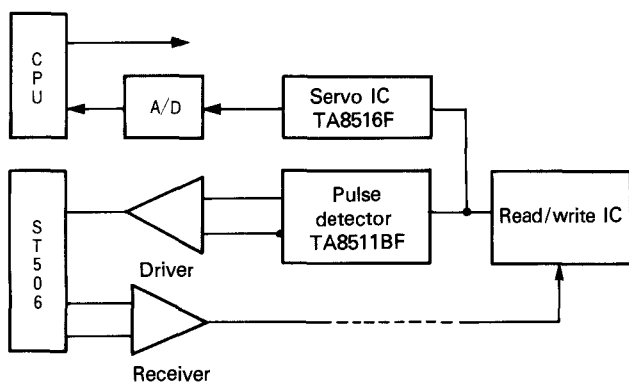
Application	Type No.	Package	Voltage	Features
Read/write IC	TA8512AF	μ PFP44(0.8mm)	+12V or +5V	5V single voltage available; includes power save function; time domain capacitor built in
Read/write IC	TA8515F	MFP44(1.0mm)	+12, +5V	Time domain capacitor built in

HDD Signal Processing LSI

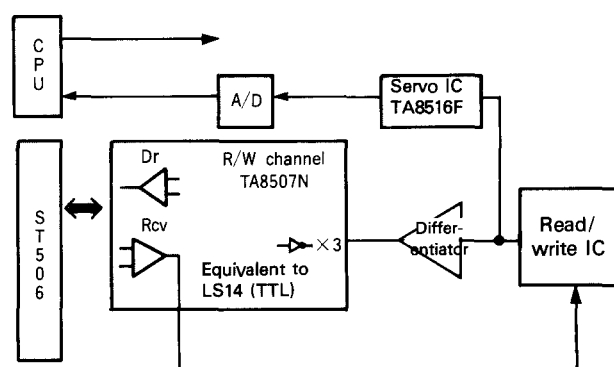
HDC/HDD System Block Diagram



Circuit Block Diagram System (using a pulse detector)



System (using a read/write channel)



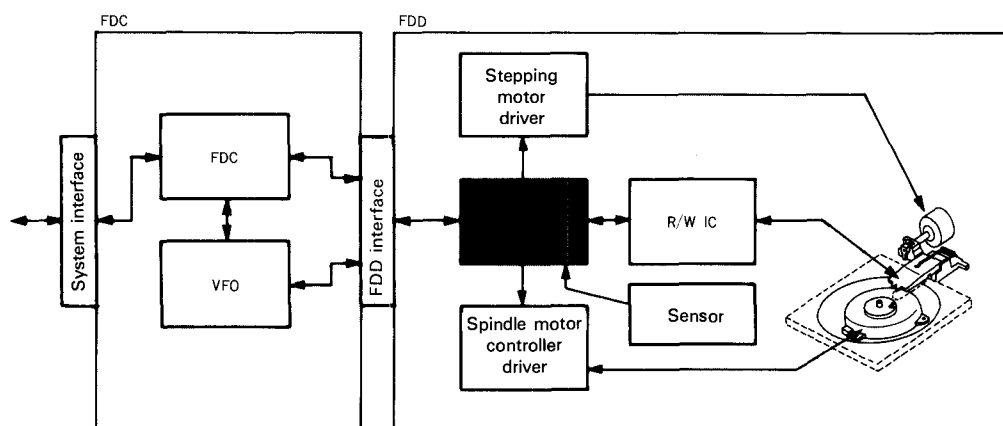
Signal Processing LSI Product Chart

Application	Type No.	Package	Voltage	Features
Read/write IC	TA8503F	PFP-20	+12V +5V	4-channel head IC, amp gain 100 x. 4-channel head IC, amp gain 200 x; power supply monitor built in. 8-channel head IC, amp gain 200 x; power supply monitor built in.
	TA8509F	PFP-20	+12V +5V	
	TA8510F	PFP-30	+12V +5V	
Read/write channel	TA8507N	Shrink 24-pin DIP	+12V +5V	Time domain system, line driver, line receiver, Schmitt trigger inverter built in.
Pulse detector	TA8511BF	MFP-30	+5V	ΔV system used for data zero-cross detection.
Servo IC	TA8516F	FLP-16	+12V	Index and sector servo signal detection IC.

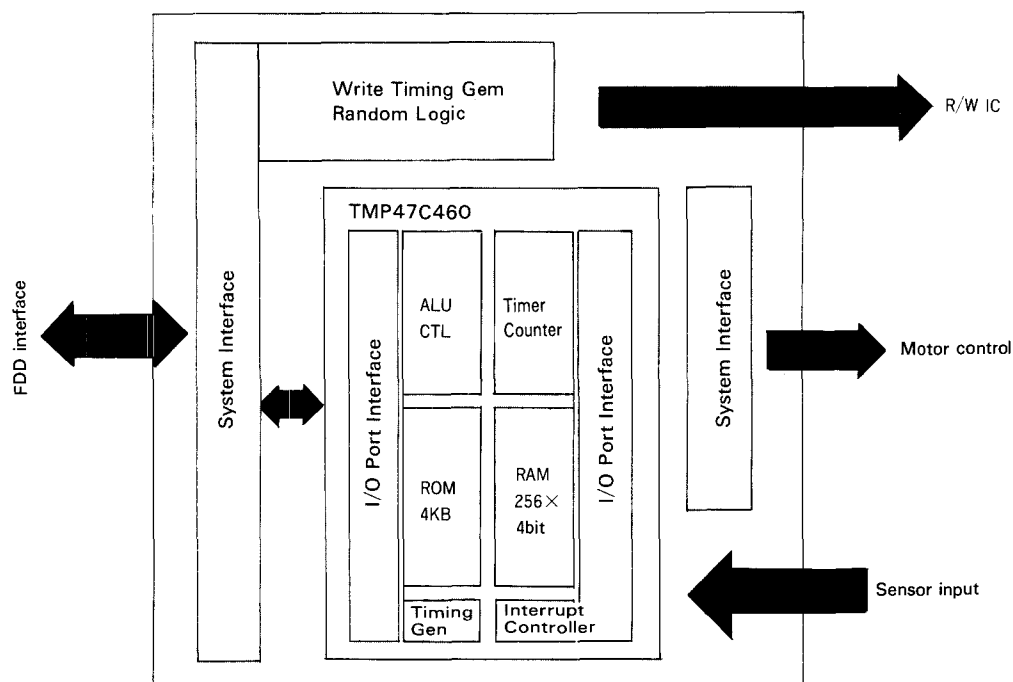
II. Control Section

FDD Mechanism Control CPU (FDMC)

FDD System Block Diagram



FDMC Block Diagram



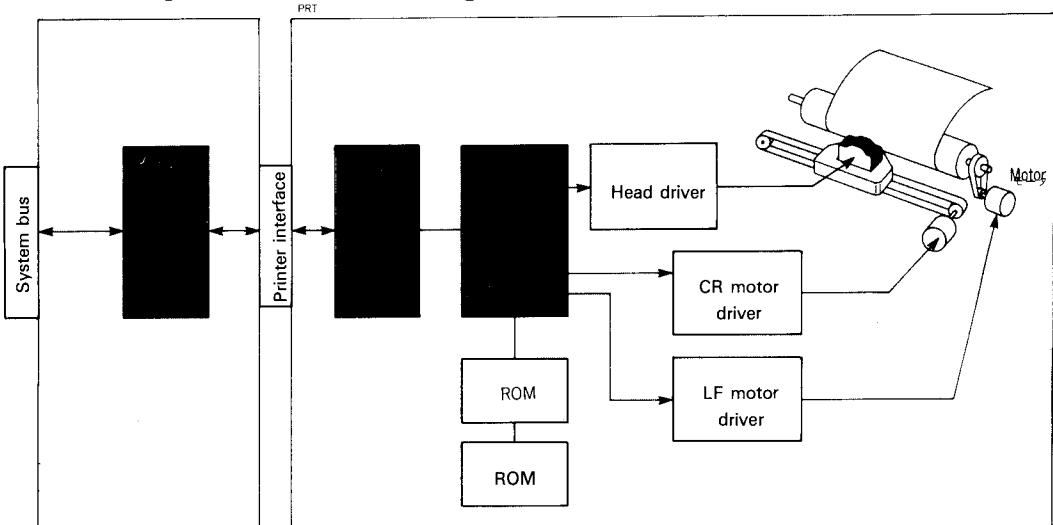
FDD Mechanism Control LSI Product Chart

Name	Type No.	Package	Voltage	Features
FDMC-4	TC8605F (C)	MFP60	+5V	For 3.5-inch FDDs, high-speed type
	TC8607F	MFP60	+5V	For 5.25-inch FDDs, high-speed type
	TC8615F-002	MFP60	+5V	For 3.5-inch FDDs, high-speed type; seek noise prevention
	TC8625F-105	MFP60	+5V	For 5.25-inch FDDs, high-speed type; seek noise prevention
FDMC-5	* TC8606F	MFP60	+5V	For 3.5-inch FDDs, high-speed type BI-CMOS
	* TC8608F	MFP60	+5V	For 5.25-inch FDDs, high speed type BI-CMOS
FDMC-7	* TC8612F	MFP80	+5V	For 3.5-inch FDDs, high-speed type, DC motor, PLL circuit built in for control

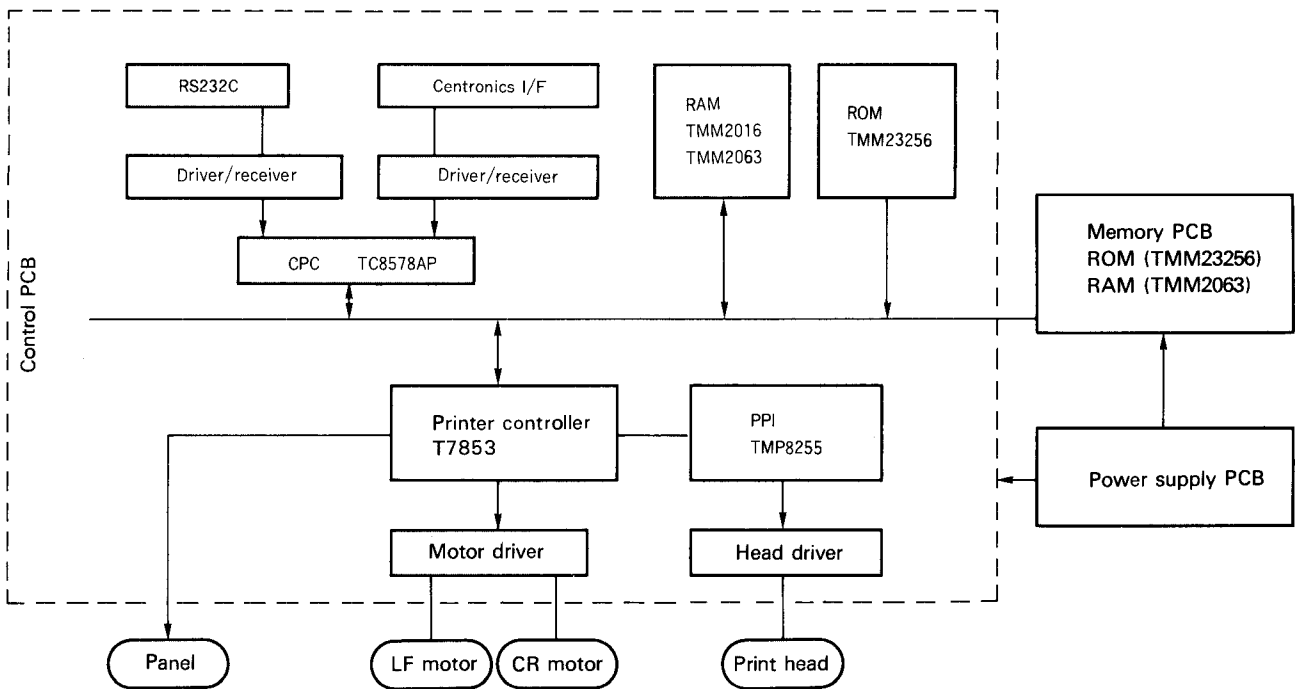
* : Under development

Printer Mechanism Control CPU, CPC (Combination Peripheral Controller)

Printer System Block Diagram



Typical Printer Mechanism Using T7853

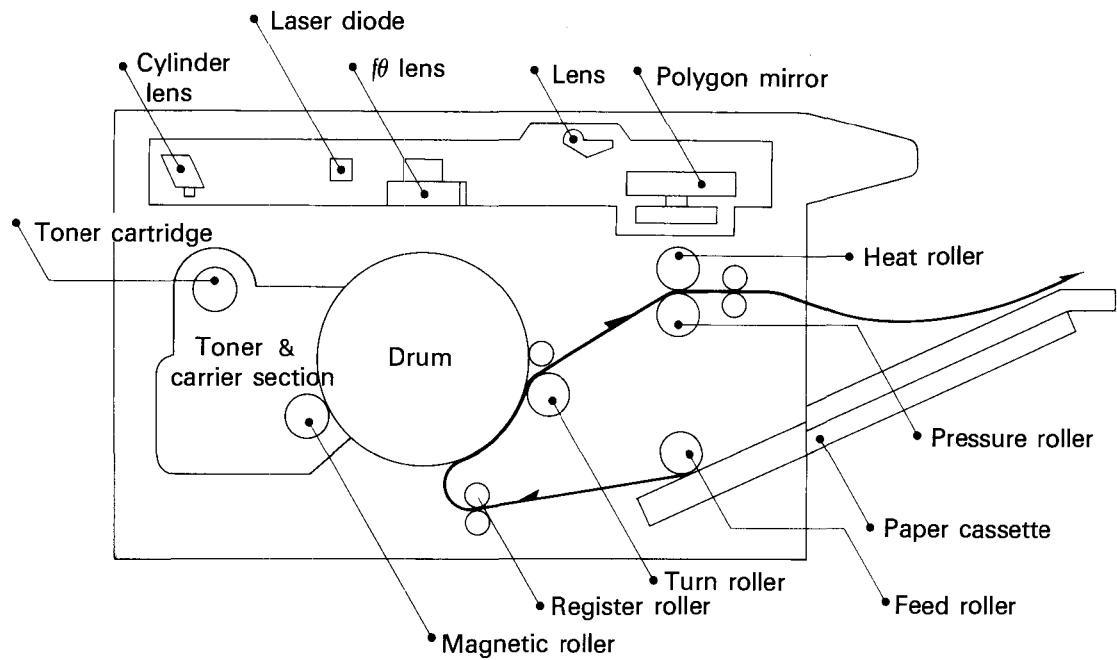


Printer Mechanism Control CPU, CPC Product Chart

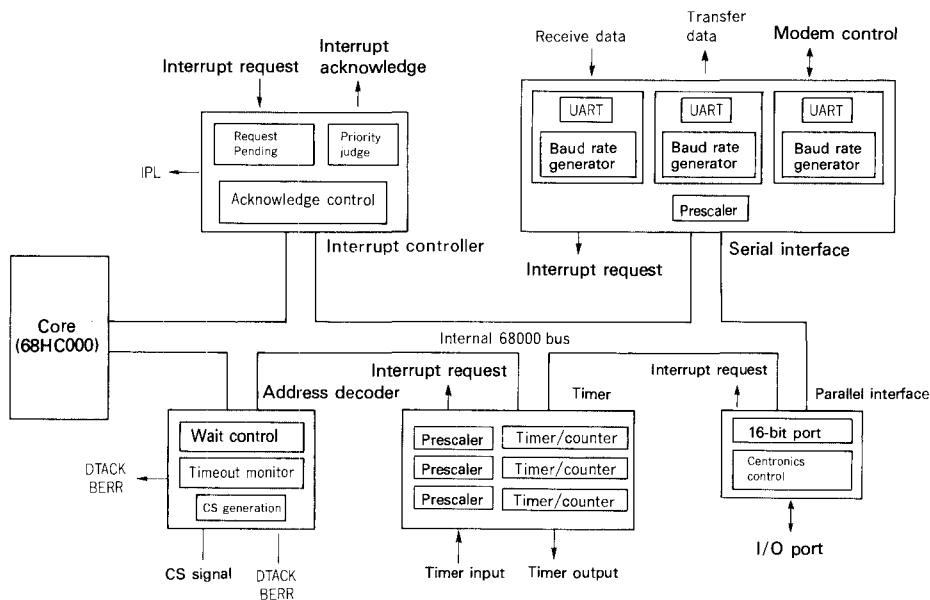
Type No.	Package	Functions	
T7853	MFP100(0.65mm)	Printer controller	
TC8576AF	MFP44	RS232C + Centronics I/O	Combination peripheral controller RS232C + Baud GEN + Centronics I/O
TC8577AP	DIP40	RS232C + Centronics output	
TC8578AP	DIP40	RS232C + Centronics input	

LBP (Laser Beam Printer)

LBP Configuration Diagram



TMP68301 Configuration



TLCS-68000 ASSP

Type No.	Function	Frequency(MHz)	Package	No. of pins	Process
TMP68301	68HC000 + SIO + PIO + TMR + ITC + CS	12.5, (16, 17)	QFP	100	CMOS

(Note): 16.67MHz-version is under development.

General-purpose 8-bit Microprocessors

TLCS-90 Series Microcontrollers

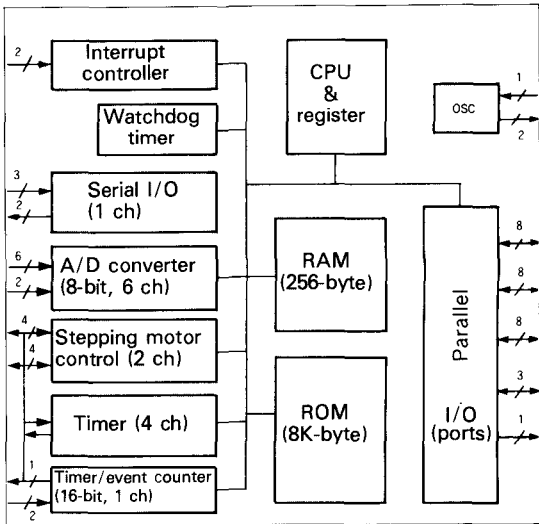
General Description

The TLCS-90 series are high-speed, high-performance 8-bit microcontrollers applicable to a variety of equipment. The TMP90C840A/841A, with its 8-bit CPU, ROM, A/D converter, multi-function timer/event counter and general-purpose serial interface integrated into a single chip, allows the expansion of external memories of programs (up to 56K-byte) and data (up to 1M-byte).

Features

- Powerful instructions: 163 basic instructions including multiplication, division, 16-bit arithmetic operations, bit manipulation instructions
- Minimum instruction execution time: 320ns (at 12.5MHz oscillation frequency)
- Internal RAM: 256-byte
- Internal ROM: 8K-byte
- Memory expansion (1M-byte for data area)
- High-accuracy 8-bit A/D converter (6 channels)
- General-purpose serial interface (1 channel)
- Multifunction 16-bit timer/event counter
- 2-channel stepping motor control port
- I/O ports (54 pins)
- Interrupt function: 10 internal, 4 external
- Watchdog timer
- Standby functions (4 HALT modes)

TMP90C840 Block Diagram



(The 90C841A is the version without a ROM)

Product List

• TLCS-90 Series (CMOS)

Type No.	Functions	ROM (byte)	RAM (byte)	I/O ports	Minimum instruction execution time (μs)	Operating temperature (°C)	Package	One-time ROM (piggyback)
TMP90C840AN/F	A/D converter: 8-bit x 6 ch Timer: 8-bit x 4 ch (PWM/PPG) Timer counter: 16-bit x 1 ch (Cap-ture/PPG) Serial: 1 ch (UART/I/O expansion) Stepping motor control Port watchdog timer Micro DMA function Programming area: 64K-byte Data area: 1M-byte	8K	256	54	(Note 1) 320	-40~85°C	SDIP64 QFP64	TMP91P640E-I0 TMP91P640E-I0/N-I0/F-I0
TMP90C841AN/F		—		28				
TMP91C640N/F		16K	512	54				* TMP91P240E/N/F
* TMP91C641N/F		—		28				
* TMP91C240N/F	Timer/counter: 8-bit x 4 ch Serial: 1 ch Programming/data area: 64K-byte	32K	1K	54	320	-20~70°C	SDIP64 QFP64	—
TMP90C041N/F		—	—	28				
* TMP90C141N/F		—	1K	28				
TMP90C802P/M	Timer/counter: 8-bit x 4 ch Serial: 1 ch Programming/data area: 64K-byte	8K	128	32	(Note 1) 320	-40~85°C	DIP40 SOP40	OTP: Planning; TMP90G802C, Piggyback
* TMP90C400N/F	Timer/counter: 8-bit x 4 ch Serial: 1 ch. Programming/data area: 64K-byte, multiple-pin	4K	128	56	(Note 1) 320	-40~85°C	SDIP64 QFP64	* TMP90P800E/N/F (8K EPROM, 256RAM)
* TMP90C844N/F	Slave bus function 90C840A with advanced I/O functions	8K	256	54	(Note 2) (250)	-40~85°C	SDIP64 QFP64	OTP: Planning
* TMP90C845N/F	External memory expanded version, 90C840A with advanced I/O Programming area: 4M-byte Data area: 8M-byte	—	256	38	(Note 2) (250)	-40~85°C	SDIP64 QFP64	—
TMP91C642N/F	VCR servo VCR dedicated circuit built in	16K	320	54	400	-20~70°C	SDIP64 QFP64	TMP91G642E/G Piggyback
* TMP90C846N/F	Flash A/D converter: 8-bit x 2 ch D/A converter: 8-bit x 2 ch Timer: 8-bit x 4 ch, 16-bit x 1 ch	8K	256	28	400	-20~70°C	SDIP42 QFP44	* TMP90P846E/N/F

* : Under development

Package
N: Plastic Shrink Dual Inline Package (SDIP)
F: Plastic Flat Package (QFP)
P: Plastic Standard Dual Inline Package (DIP)
M: Plastic Small Outline Package (SOP)
E: Ceramic Shrink Dual Inline Package (SDIC)
C: Ceramic Standard Dual Inline Package (DIC)
G: Ceramic Flat Package

(Note 1): Guaranteed for minimum instruction execution time of 320ns at an operating temperature of -20 to 70°C; 400ns at -40 to 85°C.

(Note 2): Planning for minimum instruction execution time of 250ns at an operating temperature of -20 to 70°C.

Stepping Motor Control Circuit



- **TLCS-48 Series (CMOS)**

(Notes): Packages P: Plastic Standard DIP, U: Micro Flat Package

< > Hold current, (): When ROMs are externally mounted

Microprocessor TLCS-Z80 Family

General Description

The TLCS-Z80 are a family of 8-bit microprocessor LSIs which are produced using Toshiba's latest CMOS silicon gate process. To satisfy the needs of higher performance, more compactness and lightness for electronic equipment applications, a variety of these LSIs is available. For example, (1) high-speed 6MHz, 8MHz products; (2) low power consumption; (3) diversified packages: DIP, SOP, PLCC; (4) expanded functions: composite LSIs (ASSP), etc.

The TLCS-Z80 ASSP microprocessors contain the TLCS-Z80 MPU and various peripheral LSIs (CTC, PIO, SIO, CGC, etc.) on one chip. These products' features are as follows: low power dissipation; high-speed operation; wide operation power supply and temperature range.

• TLCS-Z80 Family (CMOS)

Type No.	Function	Minimum instruction execution time (μs)	Typical power supply current (mA)	Package (no. of pins)			
				DIP	MFP	PLCC	SOP
TMPZ84C00A□-6 TMPZ84C00A□-8	Microprocessor (6/8MHz)	0.6/0.5	15/20	40	—	44	40
TMPZ84C01F	CPU + CGC(4MHz)	1.0	15	—	44	—	—
TMPZ84C02F-6	CPU + CGC(6MHz)	0.6	20	—	44	—	—
TMPZ84C10A□-6	Direct memory access controller (6MHz)		6	40	—	44	40
TMPZ84C20A□-6 TMPZ84C20A□-8	Parallel I/O controller (6/8MHz)		3/4	40	—	44	40
TMPZ84C30A□-6 TMPZ84C30A□-8	Counter timer circuit (6/8MHz)		4/5	28	—	44	28
TMPZ84C40A□-6 TMPZ84C40A□-8	Serial I/O 0 controller (6/8MHz)		4/5	40	—	—	40
TMPZ84C41A□-6 TMPZ84C41A□-8	Serial I/O 1 controller (6/8MHz)		4/5	40	—	—	40
TMPZ84C42A□-6 TMPZ84C42A□-8	Serial I/O 2 controller (6/8MHz)		4/5	40	—	—	40
TMPZ84C43AF-6	Serial I/O controller (6MHz)		4	—	44	—	—
TMPZ84C44AT-6	Serial I/O controller (6MHz)		4	—	—	44	—
TMPZ84C61AP-6	Clock generator controller (6MHz)		3	16	—	—	—

(Notes) Operating temperature: 0 to 85°C, Power supply voltage: 4.5 to 5.5V
□ Package type - P: Plastic Standard DIP (DIP) F: Plastic Mini Flat Package (MFP) T: Plastic Leaded Chip Carrier (PLCC)
M: Plastic Small Outline Package (SOP)

• TLCS-Z80 ASSP Family

Type No.	Function	Minimum instruction execution time (μs)	Typical power supply current (mA)	Package (no. of pins)		
				DIP	QFP	PLCC
TMPZ84C011AF-6 TMPZ84C011AF-8	CPU + CTC + CGC(6/8MHz) + I/O8×5	0.6/0.5	22	—	100	—
TMPZ84C013AT-6 TMPZ84C013AT-8	CPU + SIO + CTC + CGC(6/8MHz) + WDT	0.6/0.5	22	—	—	84
TMPZ84C015AF-6 TMPZ84C015AF-8	CPU + SIO + CTC + CGC(6/8MHz) + PIO + WDT	0.6/0.5	25	—	100	—
TMPZ84C112AN-6 TMPZ84C112AF-6	CPU + 256-bit RAM + I/O(8×2.5×1)	0.6	25	64	64	—
TMPZ84C710AG-6	Basic interface control processor conforming to CCITT	0.6	30/40	—	144	—
TMPZ84C810AF-6 * TMPZ84C810AF-8	CPU + SIO + CTC + CGC(6/8MHz) + DMA + MMU + WDT	0.6	TBD	—	100	—

(Notes) *: Under development, Operating temperature: -40 to 85°C, Power supply voltage: 4.5 to 5.5V
Package types - F: Plastic Flat Package (QFP), T: Plastic Leaded Chip Carrier (PLCC),
N: Plastic Shrink DIP (SDIP), G: Ceramic Flat Package (QFP)

TLCS-85 Family (CMOS)

Type No.	Function	Typical power supply current (mA)	Remarks	Package (no. of pins)			
				DIP	QFP	PLCC	SOP
TMP82C37A□-5 * TMP82C37B□-8	Programmable DMA Controller	5/TBD	5/8MHz	40	—	44	40
TMP82C51A□-2 TMP82C51A□-10	Programmable Communication Interface	1.2/3	5/10MHz	28	—	—	28
TMP82C54□-2	Programmable Interval Timer	3	10MHz	24	—	—	24
TMP82C55A□-2 TMP82C55A□-10	Programmable Peripheral Interface	2/2	5(TRD = 140ns)/10(TRD = 100ns)	40	—	44	40
TMP82C59A□-2	Programmable Interrupt Controller	1	8(TRD = 120ns)	28	—	—	28
TMP82C79□-2	Programmable Keyboard Display Interface	2	5	40	—	—	40
TMP82C255AN-2 TMP82C255AN-10	Programmable Peripheral Interface x 2	3/3	5(TRD = 140ns)/10(TRD = 100ns)	64	—	—	—
TMP82C265AF-2 TMP82C265AF-10	Programmable Peripheral Interface x 2	3/3	5(TRD = 140ns)/10(TRD = 100ns)	—	80	—	—

(Notes) *: Under development, Operating temperature: -40 to 85°C, Power supply voltage: 4.5 to 5.5V
□ Package type - P: Plastic Standard DIP (SDIP), F: Plastic Flat Package (QFP), N: Plastic Shrink DIP (DIP), M: Plastic Small Outline Package (SOP), T: Plastic Leaded Chip Carrier (PLCC)

16/32-bit Microprocessor

TLCS-68000 Family

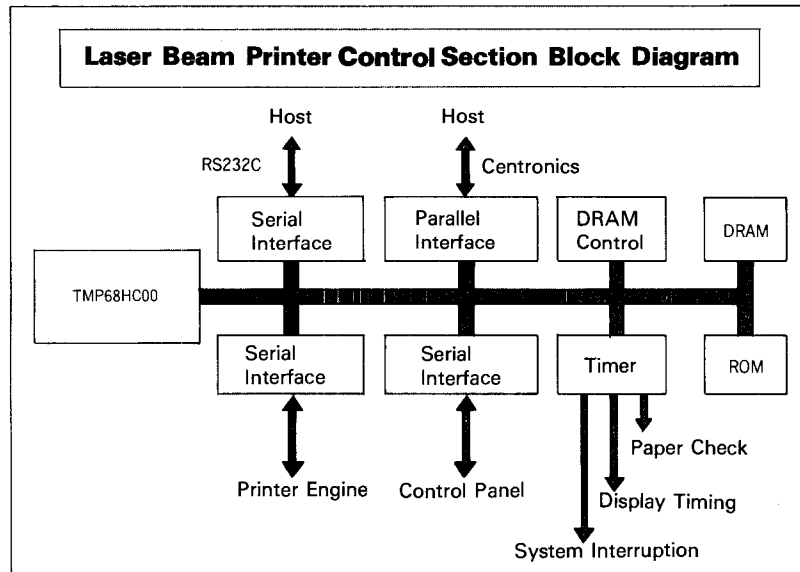
The TLCS-68000 Family is the general-purpose microprocessor family which is compatible with Motorola's M68000 Family.

The TLCS-68000 Microprocessor Family (TMP68000/08/10/20) has common 32-bit internal architecture and instruction sets and upward compatibility in object codes, allowing the move to an upgraded product by the use of existing resources.

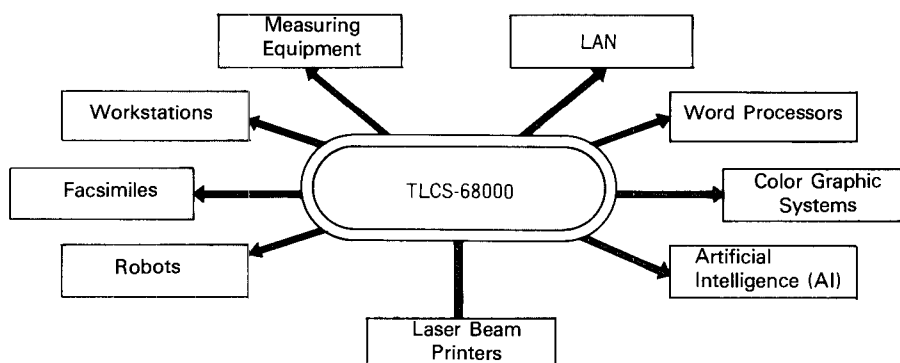
A large selection of MPUs and full-function peripherals allow the TLCS-68000 Family to construct an application system that requires high-speed data processing/calculation capability which holds large address fields, especially for use with LBPs (laser beam printers).

Features

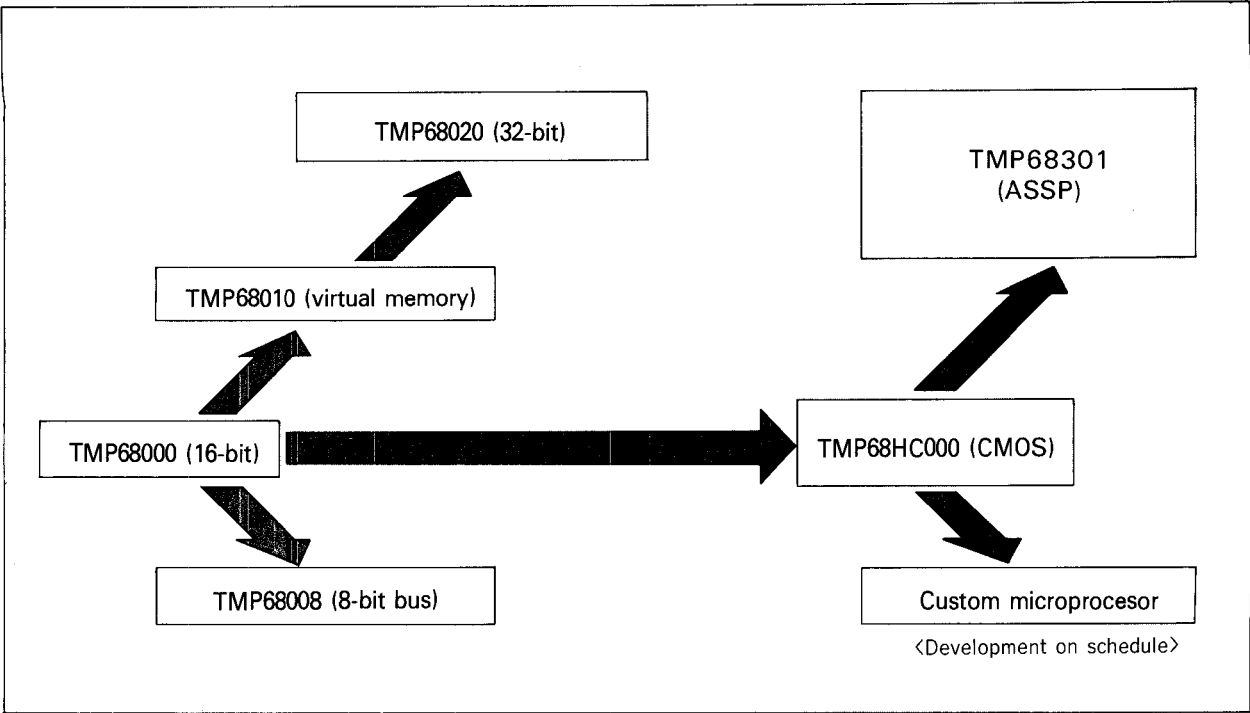
- 32-bit architecture
- Flexible addressing mode
- Powerful instruction sets
- Linear address space
- Instruction compatibility
- A large selection of highly-functional peripheral devices



• TLCS-68000 Family Application Fields



TLCS-68000 Family Expansion



TLCS-68000 Family

Power supply voltage: 4.75 to 5.25V; Operating temperature: 0 to 70°C

Type No.	Function	Frequency	Package	No. of pins	Process	Maximum power supply current (mA)	Equivalent product
TMP68020	32-bit MPU (internal: 32-bit, external: 32-bit)	12.5、16,67 20、25	YC	114	CMOS	370	MC68020
TMP68010	16-bit virtual memory MPU	8、10、12.5	P	64	NMOS	320	MC68010
TMP68000	16-bit MPU (internal: 32-bit, external: 16-bit)	8、10、12.5	P、YC、N	64/68/64	NMOS	(8/10MHz) 320 (12.5MHz) 370	MC68000
TMP68HC000	CMOS 16-bit MPU	10、12.5 16.67	P、Y、N、F	64/68/64/64	CMOS	(10MHz) 30 (16MHz) 50	MC68H000
TMP68008	16-bit MPU (external data bus: 8-bit, internal: 32-bit)	8、10	P	48	NMOS	320	MC68068
TMP68881	Floating decimal point coprocessor	12.5、16.67 20、25	YC	68	CMOS	160	MC68881
TMP68851	Page memory management unit	16.67	YC	132	CMOS	320	MC68851
TMP68451	Memory management unit	8、10	C	64	NMOS	320	MC68451
TMP68440	2-channel DMA controller	8、10	P	64	NMOS	320	MC68440
TMP68442	Expanded 2-channel DMA controller	8、10	YC	68	NMOS	320	MC68442
TMP68450	4-channel DMA controller	8、10	C	64	NMOS	420	MC68450
TMP68661	High-performance programmable communication interface	1Mbit/sec	P	28	NMOS	150	MC68661
TMP68681	Dual universal asynchronous receiver/transmitter	1Mbit/sec	P	40	NMOS	150	MC68681
TMP2681	Dual universal asynchronous receiver/transmitter (For general-purpose bus)	1Mbit/sec	P	40	NMOS	150	MC2681
TMP68230	Parallel interface/timer	8、10	P	48	NMOS	110	MC68230
TMP68901	Multifunction peripheral	4	P	48	NMOS	180	MC68901

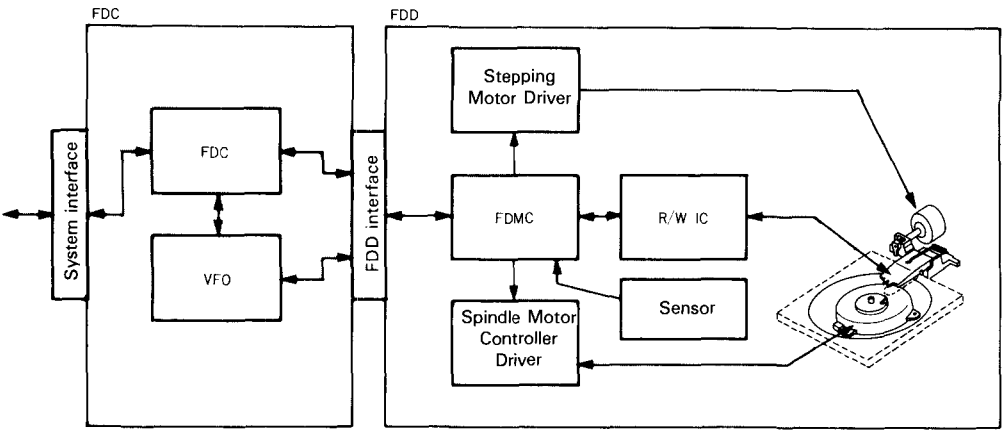
(Notes) Package C: Ceramic Standard Dual Inline Package
N: Plastic Shrink Dual Inline Package YC: Pin grid array without standoffs

• TLCS-68000 ASSP

Type No.	Function	Frequency	Package	No. of pins	Process
TMP68301	68HC000 + SIO + PIO + TMR + ITC + CS	12.5 (16.67)	QFP	100	CMOS

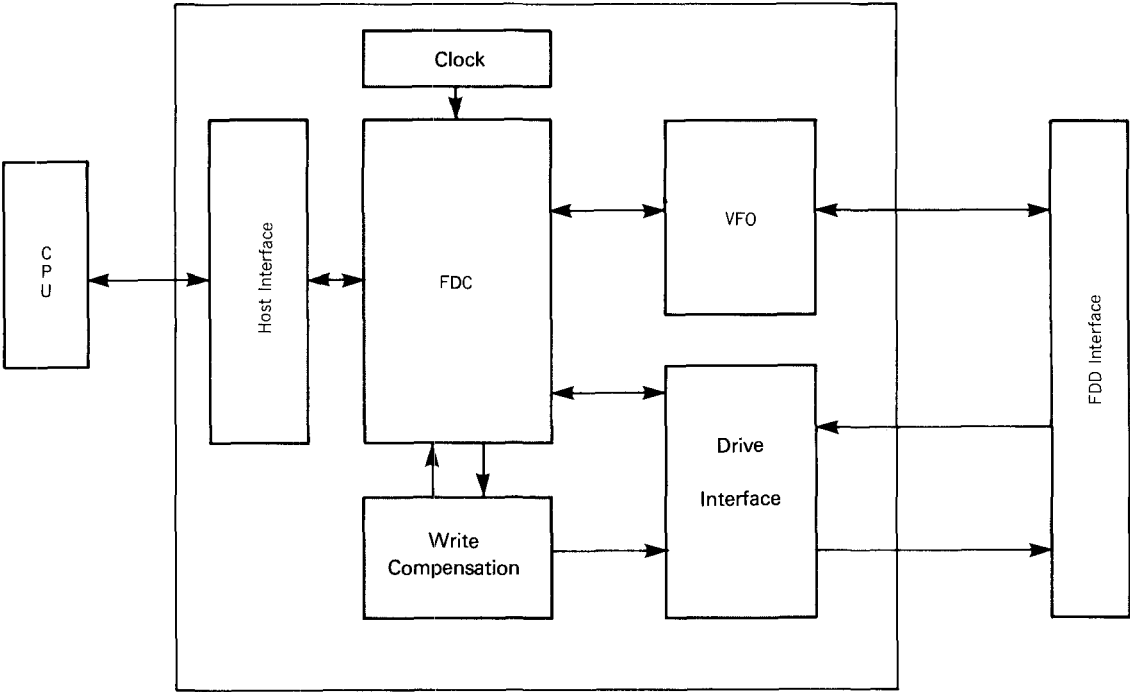
(Note): 16.67MHz-version is under development

III. System Interface Section



FDC/FDD System Block Diagram

TC8569AF Internal Block Diagram



FDC (Floppy Disk Controller) LSI Product Chart

Name	Type No.	Package	Features
FDC-1	TC8565P TC8565F	DIP40 MFP44	Floppy disk controller μPD765A compatible, CMOS process
FDC-2	TC8566AF	FP100	Single-chip floppy disk controller FDC + VFO + IBM PC compatible
FDC-3	TC8569AF	FP80	Perpendicular magnetized floppy disk controller PFDC + VFO
	TC856069F	FP80	Single-chip floppy disk controller FDC + VFO + IBM PC/AT compatible
	* TC85169F	FP80	Single-chip floppy disk controller FDC + VFO + IBM PC/AT compatible, 16-byte, with FIFO
VFO	TC8568AM	SOP24	FDC VFO IBM PC/AT compatible, multitransfer speed

*: Under development

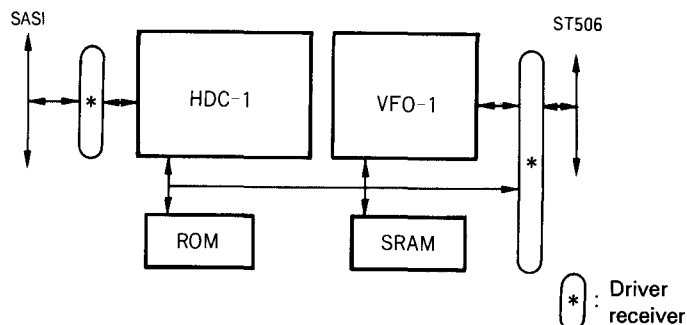
HDC and VFO System Interfaces

Circuit Block Diagram

System 1: SASI/ST506

SASI/ST506

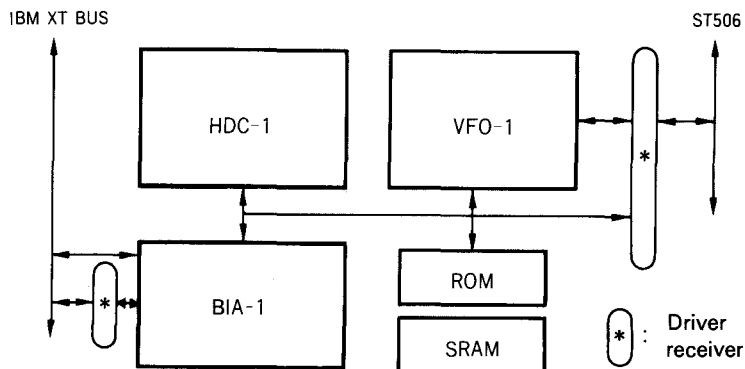
- MFM 5Mbps
- SASI 625KB/Sec
- HDC-2 for SCSI host bus



System 2: IBM XT/ST506

IBM XT/ST506

- MFM 5Mbps, RLL27 7.5Mbps
- Host DMA 1.25MB/Sec



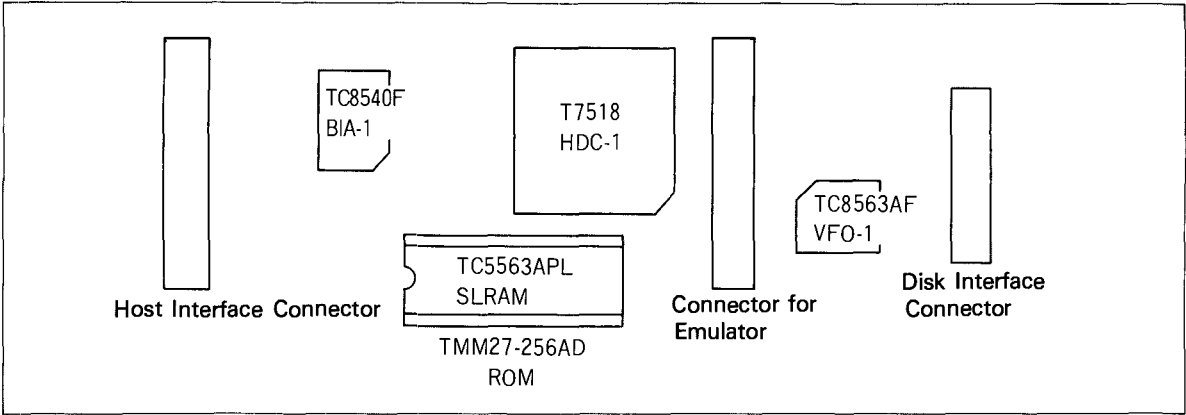
HDC (Hard Disk Controller) LSI Product Chart

Name	Type No.	Package	Features
HDC-1	T7518	LFP144	Hard disk controller, SASI system interface ST506/ESDI disk interface, 5 (10) M bps disk I/O
HDC-2	TC8561F	LPF144	Hard disk controller, SASI/SCSI system interface ST506/ESDI disk interface, 10M bps disk I/O
VFO-1	TC8563AF-88 TC8563AF-89	MFP60	Hard disk VFO IC, NRZ/RLL2.7, ENCODER/DECODER, adjustment-free type VCO, MM, delay line, for ST506, 10M bps disk I/O
VFO-2	TC8564AF	MFP60	Hard disk VFO IC, NRZ/MFM, NRZ/RLL2.7, ENCODER/DECODER adjustment-free type VCO, MM, delay line, for ESDI 10Mbps disk I/O
VFO-3	* TC85063F	MFP60	Hard disk VFO IC, NRZ/RLL1.7, ENCODER/DECODER, adjustment-free type VCO, MM, delay line, for ST506 20Mbps disk I/O
VFO-4	* TC85064F	MFP60	Hard disk VFO IC, NRZ/RLL2.7, ENCODER/DECODER, adjustment-free type VCO, MM, delay line, for ESDI 20Mbps disk I/O
BIA-1	TC8540F	FP100	Hard disk host adapter IBM-XT bus
BIA-2	TC85041F	FP100	Hard disk host adapter IBM-AT bus

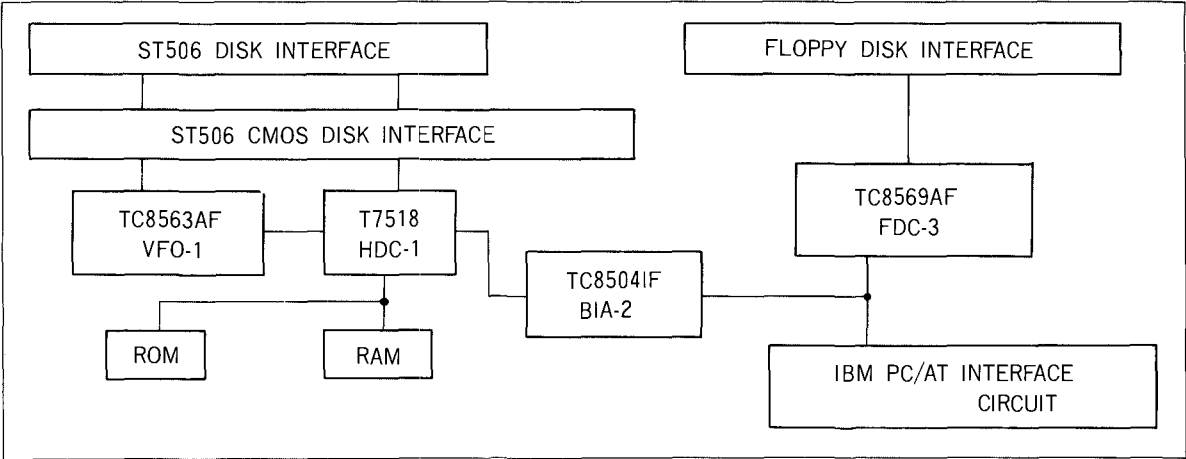
* : Underdevelopment

Disk Controller Board

FHDC400 (IBM XT/ST506CMOS) Outline



FHDC301 (IBM AT/ST506, ST506CMOS) Block Diagram



FHDC (Disk Controller Board) Product List

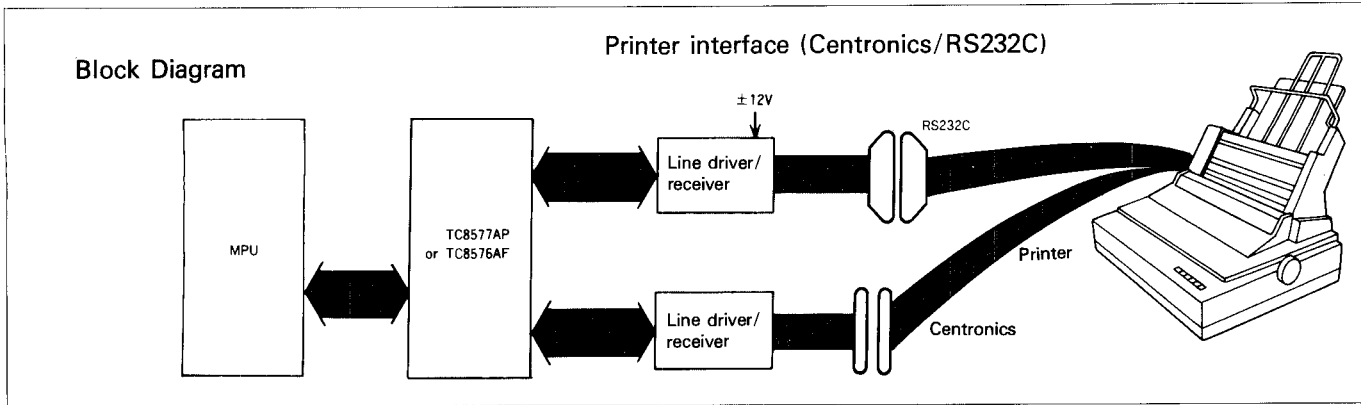
Name	Configuration	Outline dimensions	Features
*FHDC301	HDD×1 FDD×1	106.7mm × 198.1mm	Host interface — IBM PC/AT Disk interface — ST506 CMOS or ST506 Recording method: MFM (5Mbps) Single-chip controller for perpendicular magnetized floppy disk controller is built in.
FHDC400	HDD×1	65.0mm × 140.0mm	Host interface — IBM PC/XT Disk interface — ST506 CMOS Recording method: RLL 2-7 (7.5Mbps)
FHDC600	HDD×2	89.0mm × 101.6mm	Host interface — SASI Disk interface — ST506 CMOS Recording method: RLL 2-7 (8Mbps)
*FHDC620	HDD×1	100.0mm × 147.0mm	Host interface — SCSI Disk interface — ST506 CMOS Recording method: RLL2-7 (10Mbps)

*: Under development
(): Data rate

CPC and Printer Interface

Printer Interface (CPC)

Type No.	Function	Current consumption	Package
TC8576AF	Centronics parallel interface 1ch RS232C serial interface 1ch Baud rate generator built in	10mA	44-pin FP
TC8577AP			40-pin DIP
TC8578AP			40-pin DIP
TC8570AP/AF	UART 1ch	5mA	40-pin DIP 44-pin FP



Modem LSIs

Type No.	Function	Features	Process	Package
TC35107F	9600bps modem processor	GIII 9600bps to GII modulation/demodulation, GI modulation	CMOS	LFP144pin
TC35108F	9600bps modem processor	GIII 9600bps to GII modulation/demodulation, HDLC framing		LFP144pin
* TC35128F	Single-chip 9600bps modem	GIII 9600bps to GII modulation/demodulation, HDLC framing	CMOS	FP80pin
TC35100P	4800bps modem processor	GIII 4800bps modulation/demodulation	CMOS	DIP42pin
TC35100F				MFP44pin
TC35101P	4800bps modem equalizer	GIII 4800bps automatic equalizer and AGC control Used for both TC35100P, F		DIP42pin
TC35101F				MFP44pin
TC35109P	GII modem processor	GII AM mode modulation/demodulation Cable equalizer, fixed link equalizer built in	CMOS	DIP42pin
TC35109F				MFP44pin
TC35102F	Modem analog front end	AD, DA, LPF, BPF, ATT and PGA built in Connected to TC35107F or TC35100/101P	CMOS	FP80pin
TC35103F	Modem analog front end	AD, DA, LPF, BPF, ATT and PGA built in Connected to TC35108F		FP60prm
TC35942P	Single-chip 300bps modem	Conforms to CCITT V.21, full duplex FSK	CMOS	DIP20pin
TC35943P	Single-chip 300bps modem	Conforms to Bell.103, full duplex FSK		DIP20pin

* : Under development

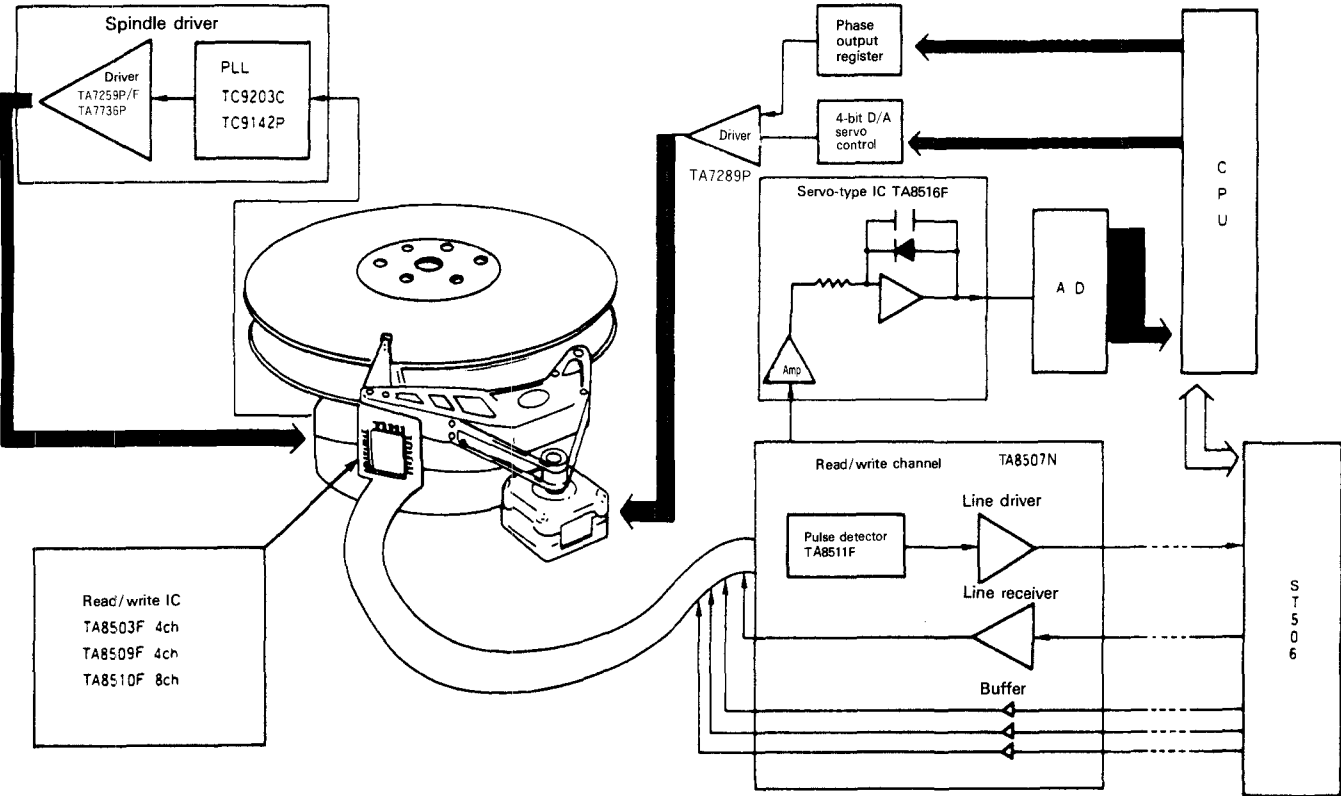
IV. Analog Interface Section

AD/DA Converters

In the field of electronics, which continues to progress at a rapid pace, digital-processing technology plays an important role. Hence the demand for A/D converters is increasing tremendously. The features required of such converters include high speed and high accuracy, but do not stop there. Ease of use — freedom from adjustment, fewer external components, single voltage and ease of interfacing with CPUs — is of growing importance.

In view of this trend, Toshiba had developed an A/D converter series that utilized monolithic C²MOS technology.

Typical HDD DA/AD Converter Applications HDD System Block Diagram



CMOS A/D Converter Series

Type No.	Resolution (bit)	Conversion time	Linearity (LSB)	Conversion method	Input channel	Output format	Power consumption (mW)	Package
TC5090AP	8	2ms	± 1 max	Integral	1ch	Time division	10	DIP16
TC5091AP	8	2ms	± 1 max	Integral	6ch	Time division	10	DIP28
TC5092AP/AF	13	8ms	± 1 typ	Integral	8ch	Parallel	10	DIP42/QFP44
TC5093AP	8	50 μ s	± 1 max	Successive approximation	8ch	Parallel	4	DIP28
TC35094P	8	19 μ s	$\pm 3/4$ max	Successive approximation	1ch	Parallel	4	DIP18/SOP20
TC35095AP/AF	8	35 μ s	$\pm 3/4$ max	Successive approximation	8ch	Serial	2.5	DIP14/SOP14
TC35096AP/AF	8	32.5 μ s	$\pm 3/4$ max	Successive approximation	4ch	Serial	2.5	DIP14
TC35097AP	8	30 μ s	$\pm 3/4$ max	Successive approximation	2ch	Serial	12	DIP8
TC35098AP	8	27.5 μ s	$\pm 3/4$ max	Successive approximation	1ch	Serial	12	DIP8
TC35080P	10	11 μ s	± 1.5 max	Successive approximation	8ch	Serial	30	DIP20
TC35081P/F	10	11 μ s	± 1.5 max	Successive approximation	1ch	Time division	30	DIP20/SOP20
TC35082P/F	10	11 μ s	± 1.5 max	Successive approximation	1ch	Parallel	30	DIP24/SOP24
TC35083P/F	10	11 μ s	± 1.5 max	Successive approximation	2ch	Selection	30	DIP24/SOP24
* TC35070P/F	8	15MHz	± 1 typ	Half Flash	1ch	Parallel	200	DIP24/SOP24

*: Under development

D/A Converter Product Chart

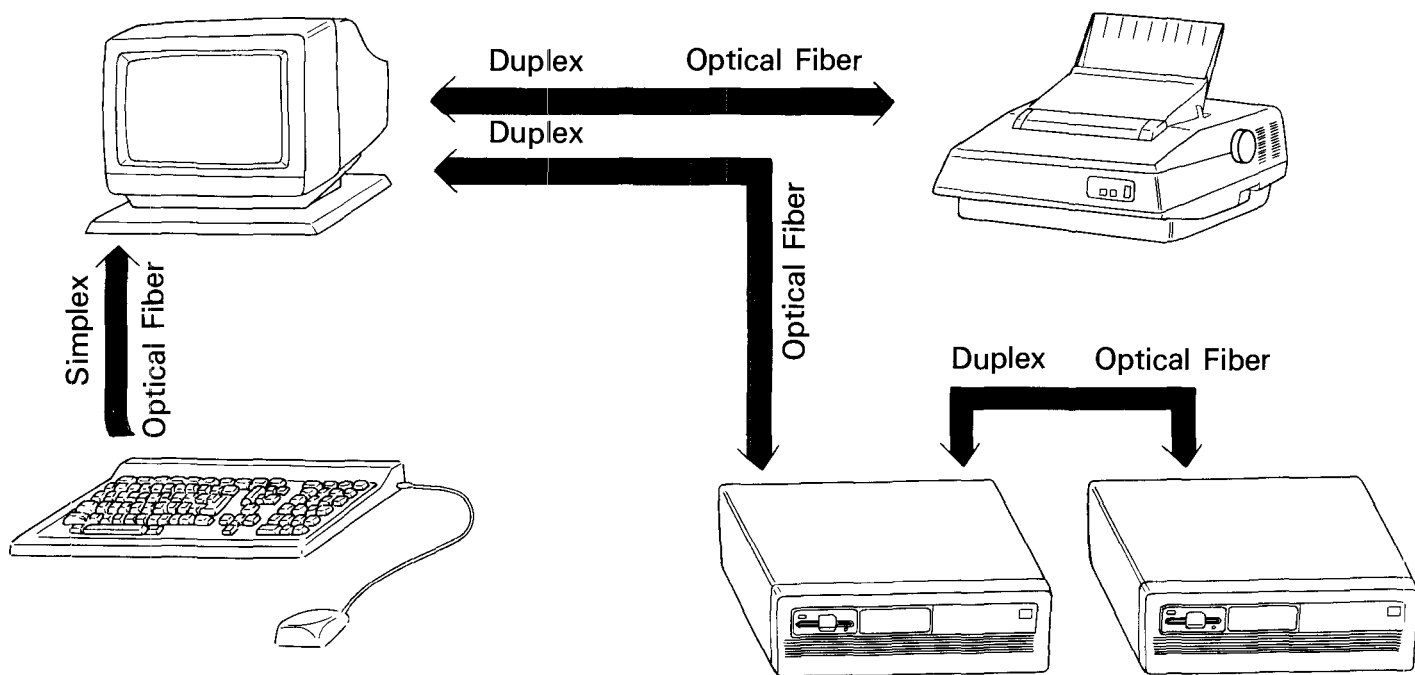
Type No.	Function	Package	Voltage	Features
TD62901P	8-bit bipolar D/A converter	DIP-16	$\pm 5V \sim \pm 18V$	Equivalent to DAC08; settling time: 100ns Silicon monolithic
TA75DA04P	8-bit 4-channel D/A converter	N-DIP-24	5V	Equivalent to AD7225; settling time: below 1 μ s Directly connected bus line ※

*: Under development

V. Interfaces Between Equipment (Optical Signal Transmission)

(TOSLINK™ : TOSHIBA FIBER OPTIC LINK)

Typical Applications



General Description

Signals between peripheral equipment units are conventionally transmitted by **electrical signals** through electrical wire. For accurate transmission of signals free from noise, however, **optical signals** moving through fiber optic links as transmitting paths are superior.

Features

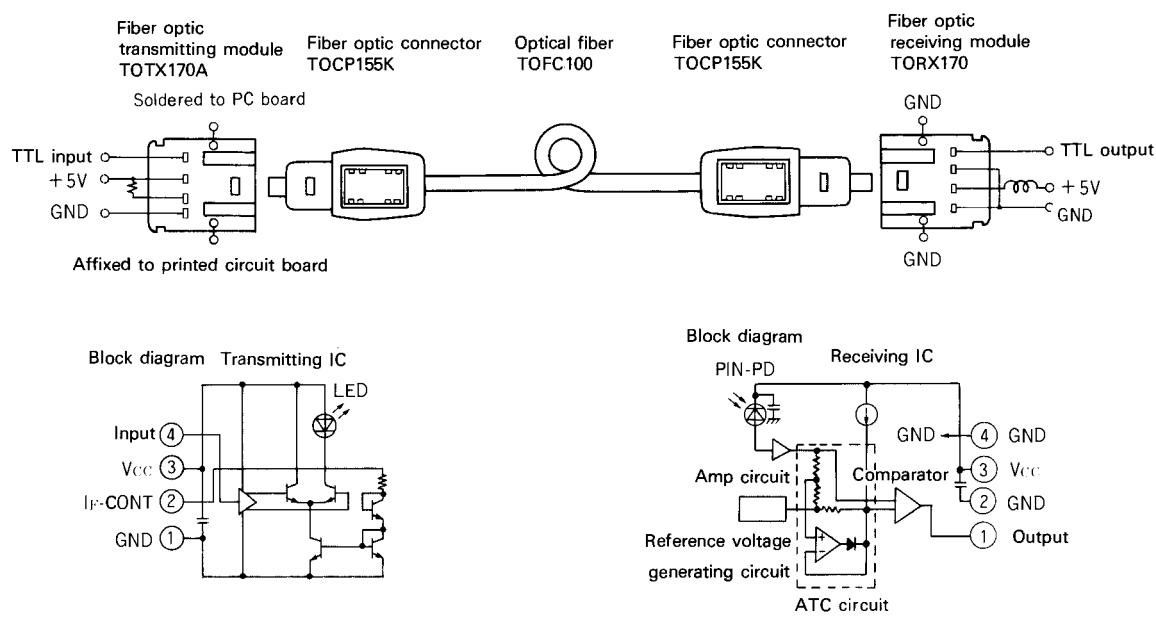
Use of optical fibers for transmitting paths offers the following advantages.

- **No effect of noise on the signal; no creation of noise.**
- **Wider-band transmission frequency. Easy multiplex transmission.**
- **Stronger insulation characteristics.**
- **Easy handling due to lightweight body and thinner fiber core.**

Products making best use of these features are called **fiber optic links**, and Toshiba supplies them in a variety to suit diverse applications.

Typical Application Example

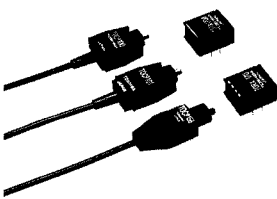
An application example using TOSLINK is described below. Block diagrams show the internal units of fiber optic transmitting and receiving modules.



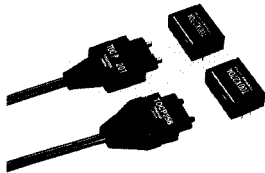
Product Chart

Type No.	Item	Direction	Data rate	Transmission distance	I/O interface	Features
TOTX170A/TORX170		Simplex	DC~6Mb/s (NRZ)	40m (APF) 55m (PCF)	TTL	● Compact (height: 8.5mm) ● Single +5V power supply ● Built-in transmitting or receiving circuits
TODX270A		Duplex	DC~6Mb/s (NRZ)	40m (APF) 55m (PCF)	TTL	● RS-232-C signals; conforms to JIS C636 I ● Standard 25-pin D-sub connector type ● Multiplex function built in; total of 8 channels for signal transmission
TOED120/TORX120		Simplex	DC~100Mb/s (NRZ)	500m (silica)	TTL/ECL	● Compact type (height: 8.5mm) ● Transmitting circuit and LED, receiving circuit and PD are built into the package
Fiber optic modem TODX705/TODX706		Duplex	DC~64kb/s	1000m (PCF)	—	● Compact type (height: 8.5mm) ● Optimum for high-speed mid-range transmission ● PD and Amp circuits are built into the fiber optic receiving module

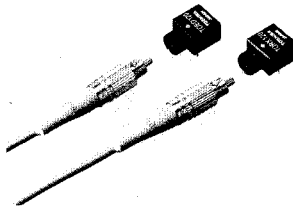
TOTX170A/TORX170



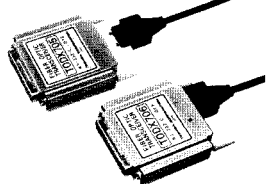
TODX270A



TOED120/TORX120



TODX705/TODX706

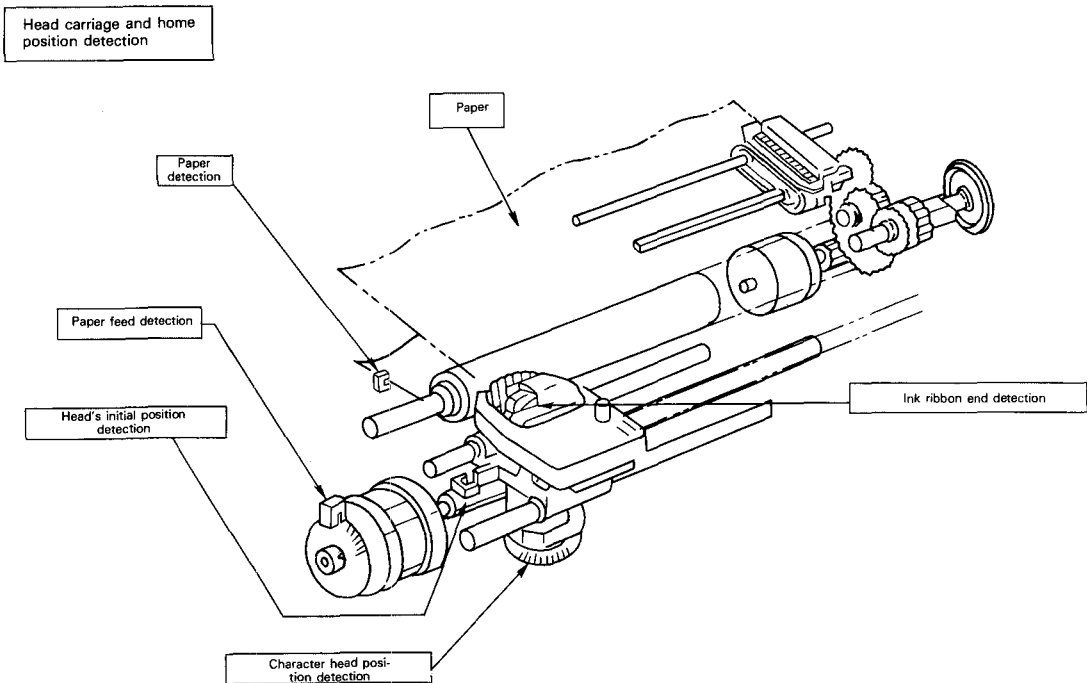


(Note) (1) APF=All plastic Fiber, PCF=Plastic Cladding Silica Fiber, Silica=Silica Fiber
(2) TOSLINK™ is a trademark of Toshiba Corporation.

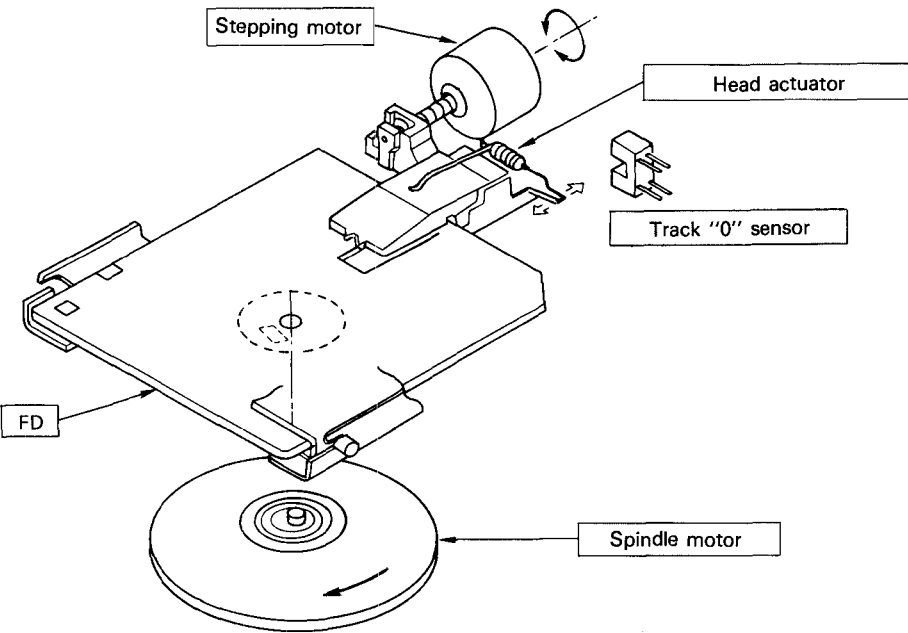
VI. Sensor Section

Photosensors (Infrared LEDs, Phototransistors, Photointerrupters)

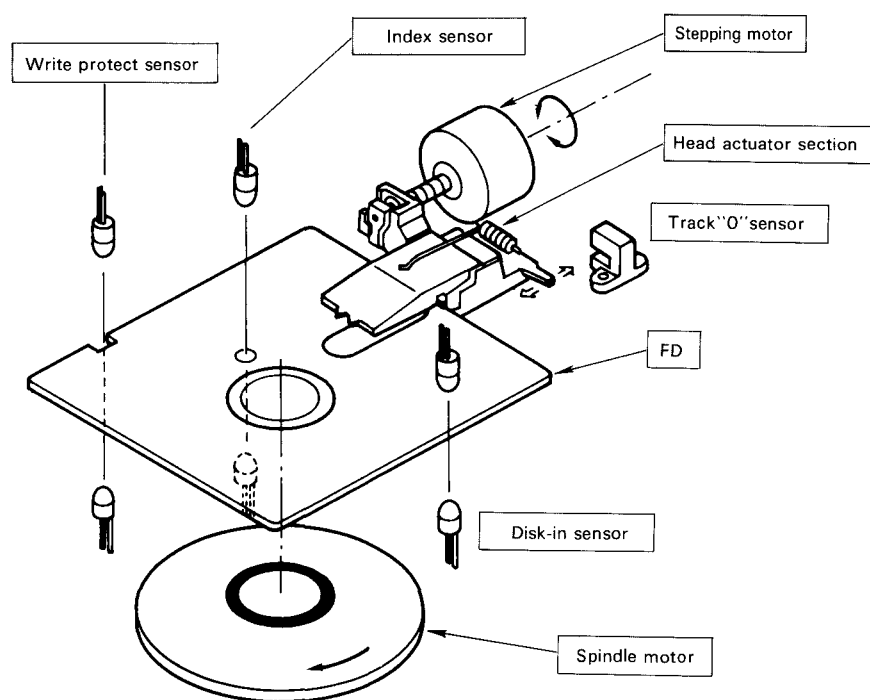
Printer Application



3.5-inch FDD Application



5.25-inch FDD Application



Photosensor Product Chart

For FDDs (Infrared LEDs, Phototransistors, Photointerrupters)

Application	Type No.	Package	Features
•Index sensor	TLN107A+TPS618	Side-view type	Can be mounted on thin types
•Write protect sensor	TLN113+TPS612 or TPS613	φ3mm plastic-stem type	General-purpose type
•Disk-in sensor	TLN119+TPS615 or TPS616	φ3mm plastic type	Easy holder mounting with 2.5mm pitch.
•Track "0" sensor	TLP805	Side surface mounting type	Gap: 3mm; slit width: 0.5mm; IC/IF = 2.5%, min.
	TLP815	Side surface mounting type	Gap: 3mm; slit width: 0.5mm; IC/IF = 5.0%, min.
	TLP804	PWB direct mounting type	Gap: 3mm; slit width: 0.5mm; IC/IF = 2.5%, min.
	TLP809		Gap: 2mm; slit width: 0.15mm; IC/IF = 3%, min.
	TLP812		Gap: 1mm; slit width: 0.4mm; IC/IF = 5%, min.
	TLP814		Gap: 1.5mm; slit width: 0.4mm; IC/IF = 2%, min.

For Printers (Photointerrupters---TLP800 Series)

Application	Type No.	Package	Gap (mm)	Slit width (mm)	Current transfer ratio IC/IF (%), MIN.	Collector/emitter voltage V _{ceo} (V), MAX.
•Paper existence detection •Paper feed detection •Head initial position detection •Head position detection •Ink ribbon end detection	TLP800A	Two-side mounting type	3	1	10	30
	TLP802	One-side mounting type	5	0.5	2.5	30
	TLP803	Box type	5	0.5	2.5	35
	TLP805	Side surface mounting type	3	0.5	2.5	30
	TLP815		3	0.5	5	35
	TLP801A	PWB direct mounting type	3	1	10	30
	TLP804		3	0.5	2.5	30
	TLP806		5	0.5	2.5	35
	TLP809		2	0.15	3	35
	TLP811		5	0.9	9	35
	TLP813		2.2	0.2	2.5	35
	TLP818		5	0.5	2.5	35
	TLP810	PWB direct mounting type Small package	1	0.4	5	35
	TLP812		1	0.4	5	35
	TLP814		1.5	0.4	2	35

For Printers (Photointerrupters---TLP1000 Series)

Application	Type No.	Package	Gap (mm)	Slit width (mm)	Output theory (during light entry)	Output format		Threshold input current IFT(mA), MAX.
						With 10k Ω	Open collector	
● Paper feed detection ● Head initial position detection ● Head position detection	TLPI000A	Two-side mounting type	3	1	H	○		2.5
	TLPI001A		3	1	L	○		2.5
	TLPI002A	One-side mounting type	5	0.5	H	○		3
	TLPI003A		5	0.5	L	○		3
	TLPI006A	Side-surface mounting type	3	0.5	H	○		4
	TLPI016		3	0.5	H		○	4
	TLPI007A		3	0.5	L	○		4
	TLPI017		3	0.5	L		○	4
	TLPI024		3	0.5	H		○	4
	TLPI034		3	0.5	H	○		4
	TLPI004A	PWB direct mounting type	3	0.5	H	○		4
	TLPI014		3	0.5	H		○	4
	TLPI005A		3	0.5	L	○		4
	TLPI015		3	0.5	L		○	4
	TLPI018		5	0.5	H		○	6
	TLPI019		5	0.5	L		○	6
	TLPI020		2.2	0.2	H		○	10
	TLPI023		5	0.5	L		○	7
	TLPI029		2	0.15	L		○	6

VII. Motor Drive,Control Section

Motor Drive IC Product Function Comparison Chart

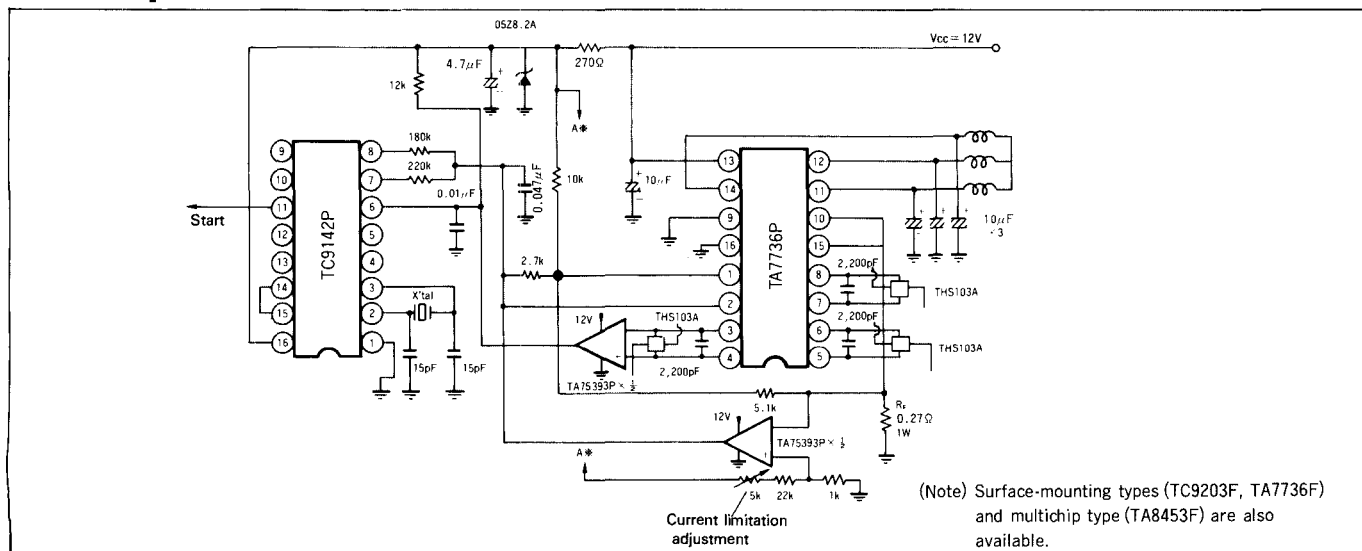
Application	Function	Type of IC used	Type No.
FDD (Floppy disk drive)	Controller	Controller	TC68001 2F(4-bit CPU)
	Spindle	Dedicated single chip	TA8453F TA8434F
		Servo	TC9142 TC9203P/F(PLL) TA7715P(F servo) TC9193F
		Hall motor	TA7736P/F(3.5) TA7259P/F(5.25)
	Head	Stepping motor	TA7774P/F TA7534P TD62M4700F TA8430AF
		Voice coil motor	TA7256P TA7272P TA8406P/F TA8470P/F
HDD (Hard disk drive)	Controller	Controller	TC8561F T7508
	Spindle	Dedicated single chip	TA8453F
		Servo	TC9193F TC9142P TC9203P/F
		Hall motor	TA7736P/F (3.5) TA7259P/F(5.25)
	Head	Stepping motor	TA7774P/F TA7289P/F TD62M4700F TA8430AF
		Voice coil motor	TA7272P TA8407P/F
Printer	Carriage	Stepping motor	TD62803P TA7289P/F TA8415P TD62308AP/B-1/F/AF TD62064AP/BP-1/F/AF
	Feed (paper, ribbon)	Stepping motor	TA7289P/F TD62803P TA8415P TD62308AP/BP-1/F/AF TD62064AP/BP-1/F/AF
	Daisy wheel drive	Stepping motor	TA7289P/F TA777P/F
	Polygon mirror drive (for laser printers)	Servo	TC9142P TC9203P/F
		Hall motor	TA7248P TA7259P TA8453F
Optical disk	Spindle	Servo	TC9142P TC9203F
		Hall motor	TA7247AP TA7248P
Facsimile	Feed	System driver	TA8411L/H
		Stepping motor	TA7289P/F TD62064AP/F/AF TD62064BP-1 TD62107BP/F
	Cutter	Bridge driver	TA7279P TA7267BP TA8419P
ETW (Electronic typewriter)	Carriage	Stepping motor	TA7289P/F TD62803P TA8425H TA8435H
	Ribbon feed	Stepping motor	TA7289P/F TA7774P/F TD62308AP/BP-1/F/AF TD62064AP/BP-1/F/AF
	Paper feed	Stepping motor	TA7289P/F TA7774P/F TD62803P TA8425H TD62308AP/BP-1/F/AF
		Bridge driver	TA7279P TA7267BP TA8419P TA8428K TA8429H
	Daisy wheel	Stepping motor	TA7289P/F
LBP (Laser beam printer)	Drum	Stepping motor	TD62803P TA8415P TA62308AP/BP-1/F/AF TD62064AP/BP-1/F/AF
	Lens, mirror	Stepping motor	TA7289P/F TA8425H TD62308AP/BP-1/F/AF TD62064AP/BP-1/F/AF
		Hall motor	TA7712P TA8412P TA8443F TA8444F
	Scanner	Stepping motor	TD62803P TA7289P/F TA8415P TD62308AP/BP-1/F/AF
	Toner hopper, sorter	Bridge driver	TA7267BP TA8419P TA8428K TA8429H
	Heat roller	Hall motor	TA7712P TA8412P TA8443F TA8444F
	Fan	Hall motor	TA7247AP TA7284P TA8414P/F TA8420AF TA8421AF
		Hall motor	TA7712P/F TA8412P TA8443F TA8444F
	Paper feed	Stepping motor	TD62803P TA7289P/F TA8415P TD62308AP/BP-1/F/AF
		Hall motor	TA8453F TC9142P/F TA7259P/F

Hall Sensor Product Chart

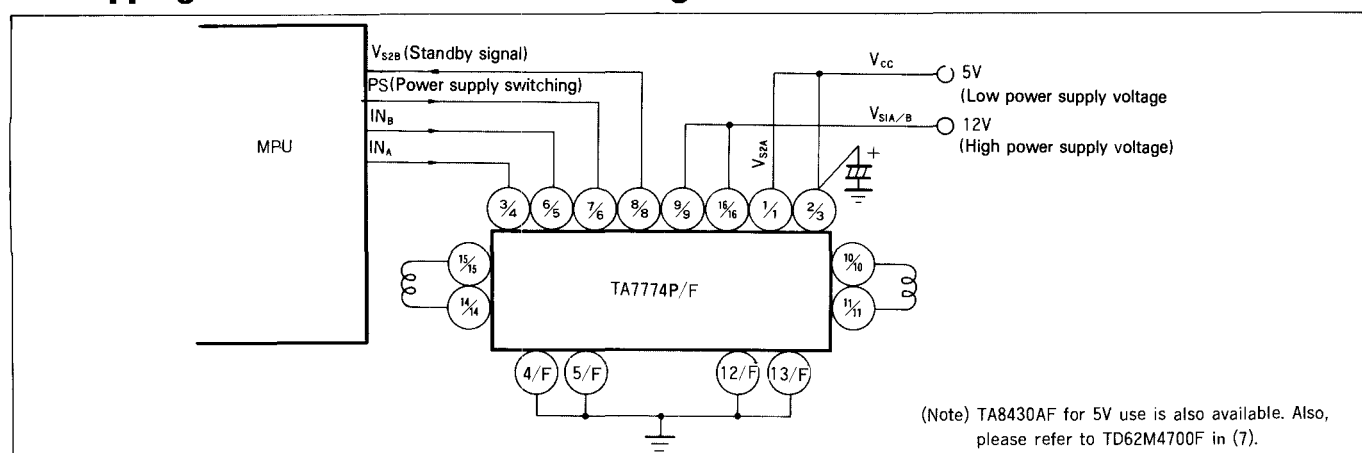
Application	Type No.	Package	V _H (mV)
DC brushless motor Position detection	THS112	SSIP	65~170
	THS119		55~140
	THS106A	SMQ (Surface-mounting type)	65~170
	THS117		55~140
	THS108A	USH (Surface-mounting, thin type)	65~170
	THS118		55~140

Typical Circuit Applications

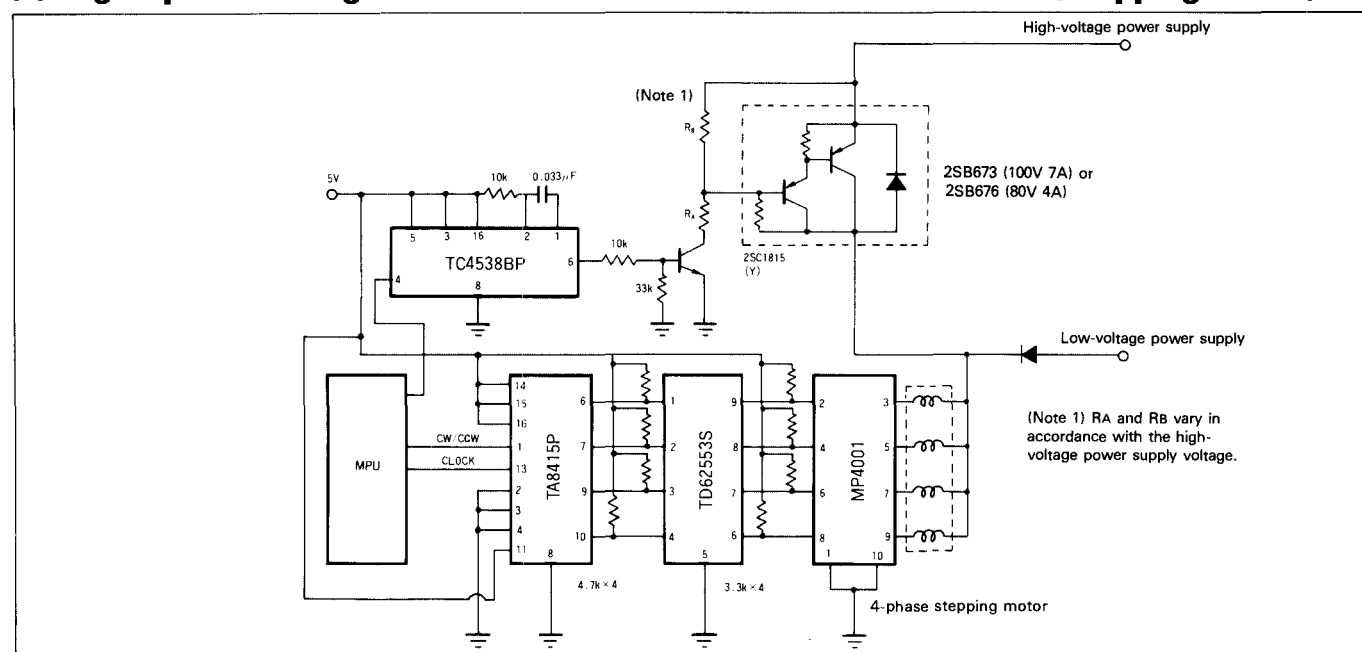
(1) PLL Spindle Motor Drive Circuit for 3.5-inch HDDs



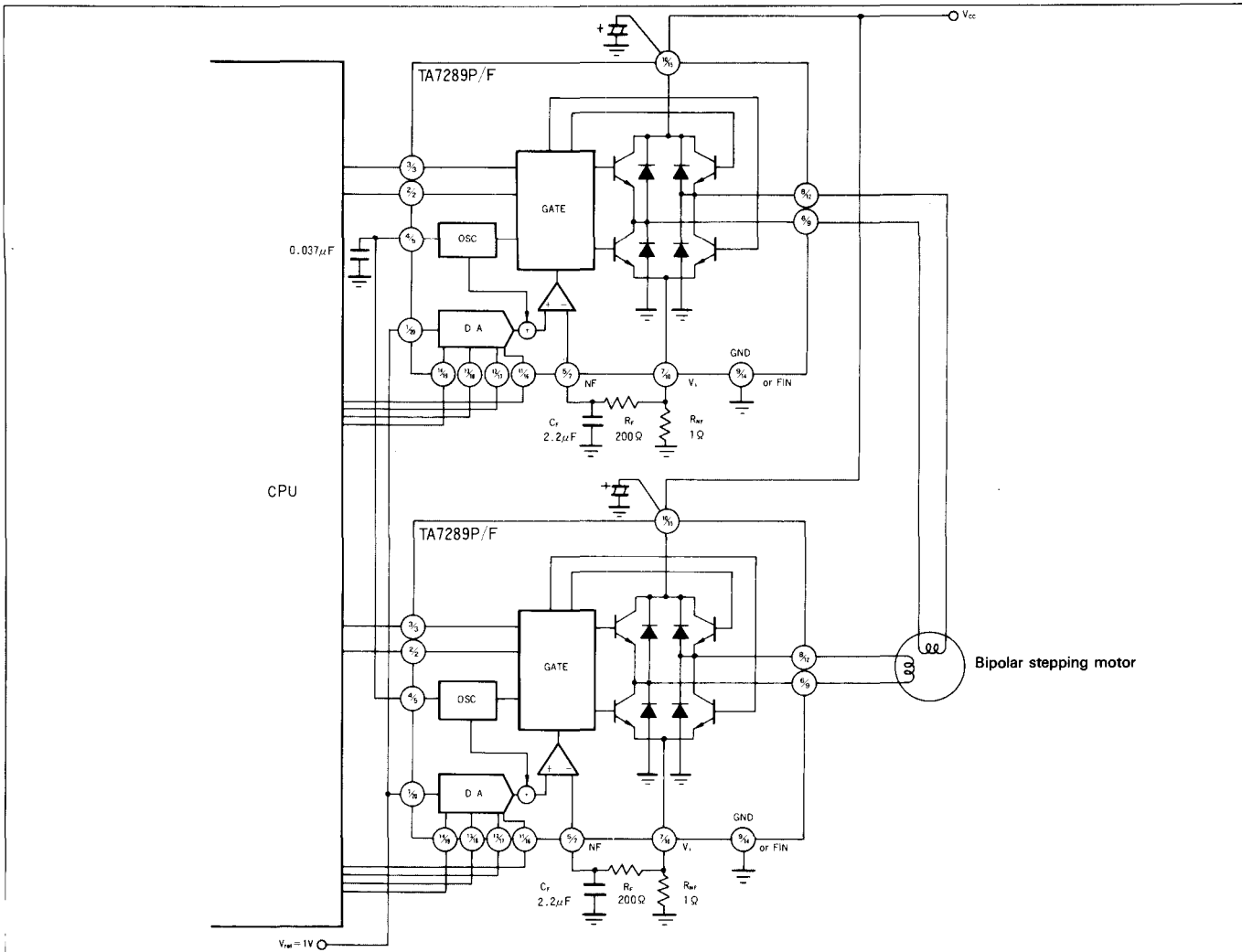
(2) Stepping Motor Drive Circuit for Driving Heads for 5.25-inch and 3.5-inch FDDs



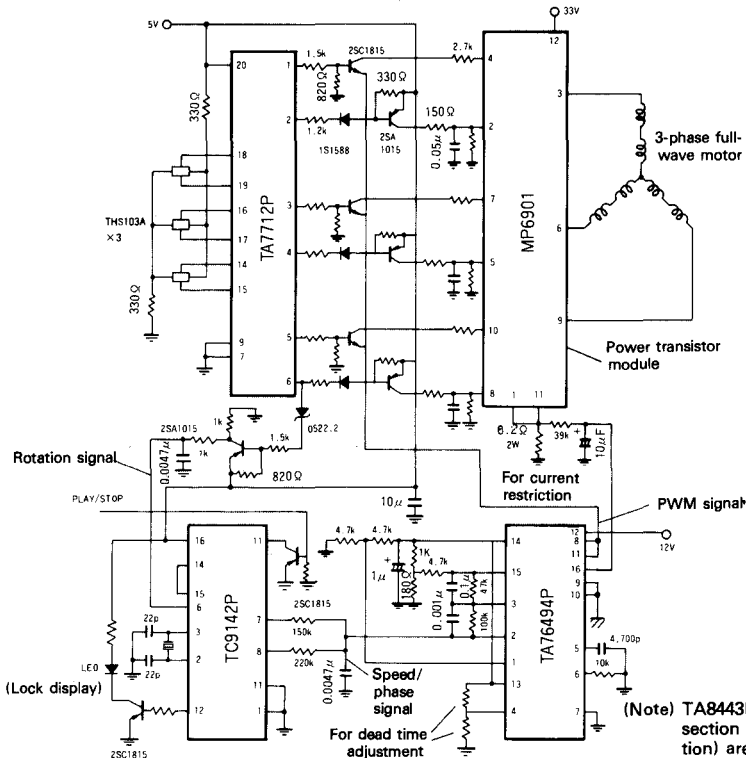
(3) High-Speed Carriage Motor Drive Circuit for PPCs and Printers (Stepping Motor)



(4) PWM Chopper Type Stepping Motor Drive Circuit (TA7289P/F)

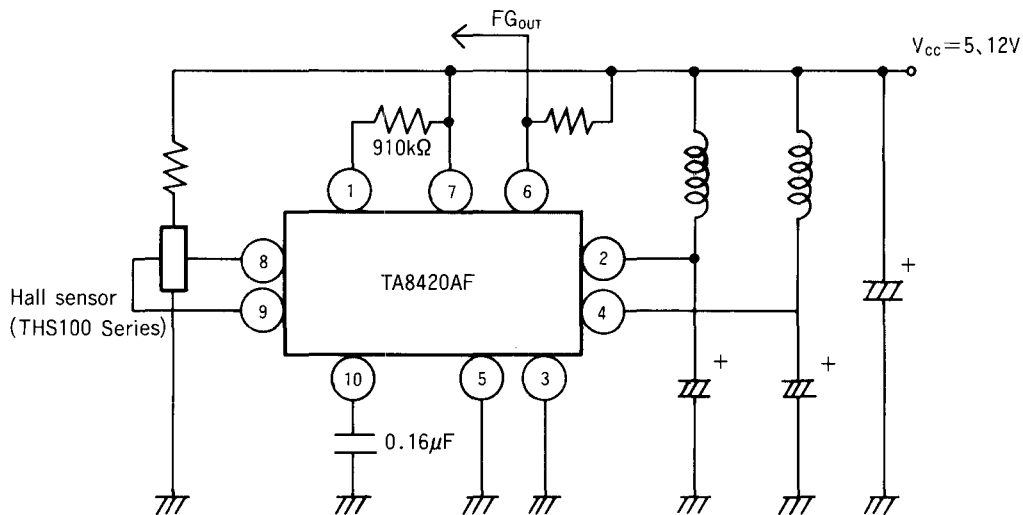


(5) PWM, PLL Hall Motor Drive Circuit (PPC developer, drum motor drive, etc.) (TA7712P, TA76494P, TC9142P, MP6901)

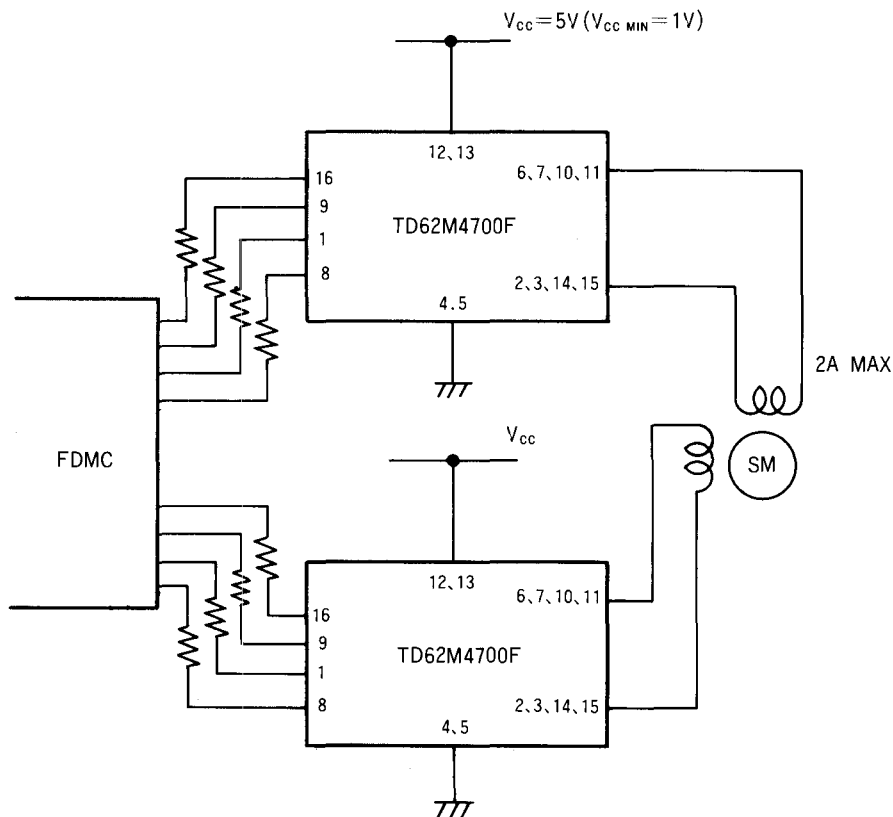


(Note) TA8443F and TA8444F (control section is a multichip construction) are in production.

(6) 2-Phase Half-Wave Fan Motor Drive Circuit (TA8420AF)



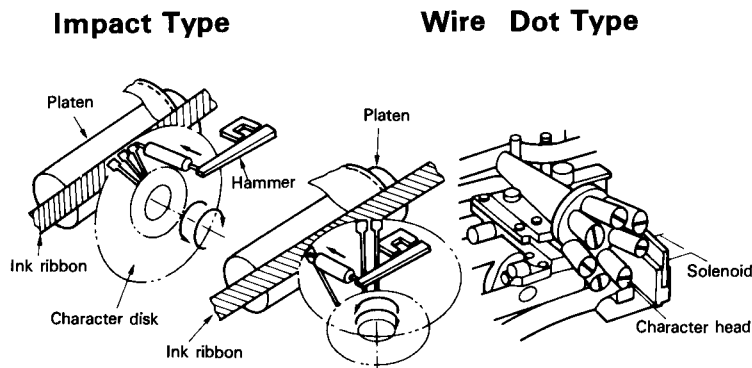
(7) Low-Voltage, High-Efficiency Stepping Motor Drive Circuit (TD62M4700F)



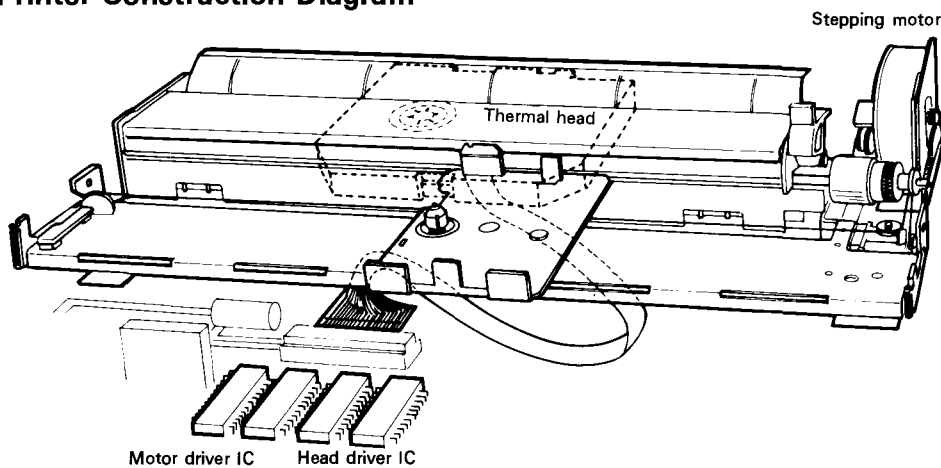
(Note) The TD62M4700F's saturation voltage is a very low 0.2V, Typ. ($I_O = 1A$) in up-down total; it is most suitable for stepping motors for 5V FDDs.

VIII. Print Head Drive Section

Printer Head Driver ICs



Printer Construction Diagram



1. Power Transistor Modules

Type No.	Package	Maximum ratings			Electrical characteristics		Remarks
		I_c (A)	V_{CEO} (V)	P_T $T_a=25^{\circ}C$ (W) * $T_c=25^{\circ}C$	h_{FE} (-) MIN	$V_{CE(sat)}$ (V) MAX	
MP4301	SIP 12-pin, full mold	3	100	4.4	2000	1.5	4 in 1, NPN×4, Di built in
MP4302		—5	—100	4.4	2000	—1.5	4 in 1, PNP×4
MP4501	SIP 12-pin, with isolated heat sink	3	100	*25	2000	1.5	4 in 1, $\frac{NPN \times 2}{PNP \times 2}$, Di built in
MP4504		—5	—100	*25	2000	—1.5	4 in 1, PNP×4
MP4505		5	100	*25	1000	2	4 in 1, $\frac{NPN \times 2}{PNP \times 2}$, Di built in
MP4508		—5	—100	*25	1000	—2	4 in 1, PNP×4

2. Printer Head Driver IC Product Chart

Application	Type No.	bit	Features	Maximum ratings			Package
				V _O (V)	I _O (mA)		
					AVERAGE	PEAK	
Thermal	TD62C805F	48	SRLD	30	100	—	μPFP80
	TD62C806F	32	SRLD	30	100	—	μPFP64
	TD62801P/F	8	SRLD	26	60	—	DIP16/PFP16
	TD62824P	24	3bit SR×8	28	80	150	DIP42
	TD6235BP	8	SRLD	30	40	—	DIP16
	TD62381P	8	Transistor array (H: ACT)	15	500	—	DIP18
	TD62382AP/F/AF	8	Transistor array (L: ACT)	50/35	50	—	DIP18/FLP18
	TD62384, 5AP/F/AF	8	Transistor array (L: ACT)	50/35	500	—	DIP18/FLP18
	TD62583AP/F/AF	8	Transistor array (L: ACT)	50/35	50	—	DIP18/FLP18
	TD62781, 2AP/F/AF	8	Transistor array (L: ACT)	50/35	—50	—	DIP18/FLP18
Ink jet	TD62083CP	8	Transistor array (H: ACT)	100	400	—	DIP18
	TD62940P	4	Head Driver	150	—	±1500	L-DIP24
	TD62981P	8	8 bit, 3-state Buffer	120	+20, −10	—	DIP20
	TD62C931F	40	SRLD	90	350	—	μPFP64
	TD62C946F	34	SRLD	250	±60	—	μPFP64
Wire dot	TD62064AP/BP-1/AF	4	Transistor array (H: ACT)	50/80/50	1500	—	DIP16/PFP16
	TD62107P/BP/F	4	Transistor array (H: ACT)	45/80	750	—	DIP16/PFP16
	TD62308AP/BP-1/AF	4	Transistor array (L: ACT)	50/80/50	—1500	—	DIP16/PFP16
	TD62164AP/AF	4	Transistor array (H: ACT)	50	700	—	DIP16/PFP16
	TD62318AP/AF	4	Transistor array (L: ACT)	50	−700	—	DIP16/PFP16
LED	TD62C938F	34	SRLD	120	350	—	μPFP64
	TD62C850N	16	SRLD (constant current output)	16	30	—	DIP30N
	TD62781, 2AP/F	8	Transistor array (H: ACT)	60	50	—	DIP18/FLP18
	TD62783, 4AP/F	8	Transistor array (H: ACT)	50	−500	—	DIP18/FLP18
	TD62786, 7AP/F	8	Transistor array (L: ACT)	50	−500	—	DIP18/FLP18

SRLD: Shift Register + Latch + Driver

IX. Memory Section

NMOS Dynamic RAM

Memory size	Type No.	Organization	Maximum access time (ns)		Minimum cycle time (ns)	Power supply (V)	Maximum power consumption (mW)		No. of pins	Mode
			t _{RAC}	t _{CAC}			Active	Standby		
256K bit	TMM41256AP/AT/AZ-10	262,144 × 1	100	50	190	5V ± 10%	440	28	16/18/16	Page Mode
	TMM41256AP/AT/AZ-12		120	60	220		396			
	TMM41256AP/AT/AZ-15		150	75	260		358			
	TMM41257AP/AT/AZ-10		100	50	190	5V ± 10%	440	28	16/18/16	Nibble Mode
	TMM41257AP/AT/AZ-12		120	60	220		396			
	TMM41257AP/AT/AZ-15		150	75	260		358			
	TMM41464AP/AT/AZ-10	65,536 × 4	100	50	190	5V ± 10%	440	28	18/18/20	Page Mode
	TMM41464AP/AT/AZ-12		120	60	220		396			
	TMM41464AP/AT/AZ-15		150	75	260		358			

CMOS Dynamic RAM

Memory size	Type No.	Organization	Maximum access time (ns)		Minimum cycle time (ns)	Power supply (V)	Maximum power consumption (mW)		No. of pins	Mode
			t _{RAC}	t _{CAC}			Active	Standby		
256K Bit	※ TC51256P/T/Z-60	262,144 × 1	60	20	115	5V ± 10%	495	5.5	16/18/16	Fast Page Mode
	※ TC51256P/T/Z-70		70	20	130		440			Fast Page Mode Low Power Version
	※ TC51256P/T/Z-80		80	20	150		385			
	※ TC51256PL/TL/ZL-80		80	20	150		385	11		
1M Bit	TC511000AP/AJ/AZ-70	1,048,576 × 1	70	20	130	5V ± 10%	440	Fast Page	18/26/20	Fast Page Mode
	TC511000AP/AJ/AZ-80		80	20	150		385			
	TC511000AP/AJ/AZ-100		100	25	180		330			
	TC511000APL/AJL/AZL-70		70	20	130	5V ± 10%	440	1.1	18/26/20	Fast Page Mode Low Power Version
	TC511000APL/AJL/AZL-80		80	20	150		385			
	TC511000APL/AJL/AZL-100		100	25	180		330			
	TC511001AP/AJ/AZ-70		70	20	130	5V ± 10%	440	5.5	18/26/20	Nibble Mode
	TC511001AP/AJ/AZ-80		80	20	150		385			
	TC511001AP/AJ/AZ-100		100	25	180		330			
	TC511002AP/AJ/AZ-70	262,144 × 4	70	20	130	5V ± 10%	440	5.5	18/26/20	Static Column Mode
	TC511002AP/AJ/AZ-80		80	20	150		385			
	TC511002AP/AJ/AZ-100		100	25	180		330			
	TC514256AP/AJ/AZ-70		70	20	130	5V ± 10%	440	5.5	20/26/20	Fast Page Mode
	TC514256AP/AJ/AZ-80		80	20	150		385			
	TC514256AP/AJ/AZ-100		100	25	180		330			
	TC514256APL/AJL/AZL-70		70	20	130	5V ± 10%	440	1.1	20/26/20	Fast Page Mode Low Power Vision
	TC514256APL/AJL/AZL-80		80	20	150		385			
	TC514256APL/AJL/AZL-100		100	25	180		330			
	TC514258AP/AJ/AZ-70		70	25	130	5V ± 10%	440	5.5	20/26/20	Static Column Mode
	TC514258AP/AJ/AZ-80		80	25	150		385			
	TC514258AP/AJ/AZ-100		100	30	180		330			
4M Bit	※ TC514266AP/AJ/AZ-70	4,194,304 × 1	70	20	130	5V ± 10%	440	5.5	20/26/20	Fast Page Mode with Write Per Bit
	TC514266AP/AJ/AZ-80		80	20	150		385			
	TC514266AP/AJ/AZ-100		100	25	180		330			
	TC514266AP/AJ/AZ-10		100	25	180		330			
	※ TC514100J/Z-80	1,048,576 × 4	80	20	150	5V ± 10%	550	5.5	26/20	Fast Page Mode
	※ TC514100J/Z-10		100	25	180		468			
	※ TC514100JL/ZL-80		80	20	150	5V ± 10%	550	2.2	26/20	Fast Page Mode Low Power Version
	※ TC514100JL/ZL-10		100	25	180		468			
	※ TC514101J/Z-80		80	20	150	5V ± 10%	578	5.5	26/20	Nibble Mode
	※ TC514101J/Z-10		100	25	180		495			
	※ TC514102J/Z-80		80	20	150	5V ± 10%	550	5.5	26/20	Static Column Mode
	※ TC524102J/Z-10		100	25	180		468			
	※ TC514400J/Z-80	1,048,576 × 4	80	20	150	5V ± 10%	578	5.5	26/20	Fast Page Mode
	※ TC514400J/Z-10		100	25	180		495			
	※ TC514400JL/ZL-80		80	20	150	5V ± 10%	578	2.2	26/20	Fast Page Mode Low Power Version
	※ TC514400JL/ZL-10		100	25	180		495			
	※ TC514402J/Z-80		80	20	150	5V ± 10%	578	5.5	26/20	Static Column Mode
	※ TC514402J/Z-10		100	25	180		495			
	※ TC514410J/Z-80		80	20	150	5V ± 10%	578	5.5	26/20	Fast Page Mode with Write Per Bit
	※ TC514410J/Z-10		100	25	180		495			

Video Memory

Memory size	Type No.	Organization	Random port access			Serial port access (ns)		Maximum power consumption (mW)		No. of pins	Package width (inch)	Device type
			t _{RAC}	t _{CAC}	cycle Time	Access Time	Cycle Time	Active	Standby			
1M Bit	TC521000P/J	262,144 × 4		—		20	30	550	110	40/40	DIP : 0.6 SOJ : 0.4	Field Memory
	TC524256P/J/Z	262,144 × 4	100	50	190	25	30	605	55	28/32/28	ZIP : 0.4(height) SOJ : 0.4 DIP : 0.4	Multi-Port DRAM
			120	60	220	35	40	550	55			
	TC524257P/J/Z		100	50	190	25	30	605	55	28/32/28	ZIP : 0.4(height) SOJ : 0.4 DIP : 0.4	
			120	60	220	35	40	550	55			
	TC524256AJ/AZ		100	30	180	25	30	825	55	28/28	ZIP : 0.4 ZIP : 0.4(height)	
			120	35	210	35	40	770	55			
	TC524258AJ/AZ		100	30	180	25	30	825	55			
			120	35	210	35	40	770	55	40/40	DIP : 0.6 SOJ : 0.4	
	TC528126AP/AJ	131,072 × 8	100	30	180	25	30	825	55			
			120	35	210	35	40	770	55			
			100	30	180	25	30	825	55			
TC528128AP/AJ	120		35	210	35	40	770	55				

Package — P: Plastic DIP, J: SOJ, Z: ZIP

Dynamic RAM Module

Memory size	Type No.	Organization	Access time T _{RAC} (ns)	No. of pins	Assembly side	Remarks
4M-bit	THM85100AS/AL-70/80/10	512K × 8	70/80/100	30	Single	With $\overline{OE}$
	THM41000AL-70/80/10	1M × 4		25	Single	I/O separate
	THM14020AZ-70/80/10	4M × 1		23	Double	
8M-bit	THM81000AS/AL-70/80/10	1M × 8		30	Single	
	HM81020AL-70/80/10			30	Double	Low profile
9M-bit	THM91000AS/ASG/AL-70/80/10	1M × 9		30	Single	
	THM91010ASG-70/80/10			30	Single	9 I/O commons
	THM91020AL-70/80/10			30	Double	Low profile
		THM362500AS/ASG-70/80/10		256K × 36	72	Single
18M-bit	THM365120AS/ASG-70/80/10	512K × 36		72	Double	

(Note 1) AS: Socket type (solder pins), ASG: Socket type (all pins), AL: pin type, AZ: ZIP type
(Note 2) The table shown above lists only the fast page mode products. Products in nibble mode and static column mode are also available.

Pseudo Static RAM

Memory size	Type No.	Organization	Maximum access time (ns)	Minimum cycle time (ns)	Power supply (V)	Maximum power consumption (mW)		No. of pins	Package width (inch)
						Active	Standby		
256K Bit	TC51832P/SP/F-85	32,768×8	85	135	5V±10%	303	5.5	28	0.6(P) 0.3(SP) 0.45(F)
	TC51832P/SP/F-10		100	160		248			
	TC51832P/SP/F-12		120	190		220			
	TC51832PL/SPL/FL-85		85	135		303	0.55		
	TC51832PL/SPL/FL-10		100	160		248			
	TC51832PL/SPL/FL-12		120	190		220			
1M Bit	TC518128AP/ASP/AF/AFW-80	131,072×8 (CE1, CE2) Type	80	130	5V±10%	385	5.5	32	0.6(P) 0.3(SP) 0.45(F) 0.525(FW)
	TC518128AP/ASP/AF/AFW-10		100	160		330			
	TC518128AP/ASP/AF/AFW-12		120	190		275			
	TC518128APL/ASPL/AFL/AFWL-80		80	130		385	1.1		
	TC518128APL/ASPL/AFL/AFWL-10		100	160		330			
	TC518128APL/ASPL/AFL/AFWL-12		120	190		275			
	※ TC518128APL/AFL/AFWL-80LV	80	130	385		1.1 (0.55)			
	※ TC518128APL/AFL/AFWL-10LV	100	160	330					
	※ TC518128APL/AFL/AFWL-12LV	120	190	275					
	※ TC518129AP/ASP/AF/AFW-80	80	130	385		5.5			
	※ TC518129AP/ASP/AF/AFW-10	100	160	330					
	※ TC518129AP/ASP/AF/AFW-12	120	190	275					
	※ TC518129APL/ASPL/AFL/AFWL-80	80	130	385		1.1			
	※ TC518129APL/ASPL/AFL/AFWL-10	100	160	330					
	※ TC518129APL/ASPL/AFL/AFWL-12	120	190	275					
	※ TC518129APL/AFL/AFWL-80LV	80	130	385		1.1 (0.55)			
	※ TC518129APL/AFL/AFWL-10LV	100	160	330					
	※ TC518129APL/AFL/AFWL-12LV	120	190	275					

Package — P: Plastic DIP, SP: Slim Plastic DIP, F: Flat Package SOP

※: New AFW products

Static RAM

Memory size	Type No.	Organization	Maximum access time (ns)	Minimum cycle time (ns)	Power supply (V)	Maximum power consumption (mW)		No. of pins	Package width (inch)
						Active	Standby		
64K Bit	TMM2063AP-70	8,192×8	70	70	5V±10%	440	55	28	0.3
	TMM2063AP-10		100	100					
	TMM2063AP-12		120	120					
	TMM2064AP-70	8,192×8	70	70	5V±10%	440	55	28	0.6
	TMM2064AP-10		100	100					
	TMM2064AP-12		120	120					
	TC5563APL-10	8,192×8	100	100	5V±10%	220	0.55	28	0.3
	TC5563APL-12		120	120					
	TC5563APL-15		150	150					
	TC5563APL-10L		100	100			0.165		
	TC5563APL-12L		120	120					
	TC5563APL-15L		150	150					
	TC5564APL/AFL-15	8,192×8	150	150	5V±10%	220	0.005	28	0.6/0.45
	TC5564APL/AFL-20		200	200					
	TC5565APQ/AFL-10	8,192×8	100	100	5V±10%	220	0.55	28	0.6/0.45
	TC5565APL/AFL-12		120	120					
	TC5565APL/AFL-15		150	150					
	TC5565APL/AFL-10L		100	100			0.165		
TC5565APL/AFL-12L	120		120						
TC5565APL/AFL-15L	150		150						
256K Bit	TC55257APL/AFL-85	32,768×8	85	85	5V±10%	330	0.55	28	0.6/0.45
	TC55257APL/AFL-10		100	100					
	TC55257APL/AFL-12		120	120					
	TC55257APL/AFL-85L		85	85			0.165		
	TC55257APL/AFL-10L		100	100					
	TC55257APL/AFL-12L		120	120					
	TC55257BPL/BFL/BSPL-85	32,768×8	85	85	5V±10%	330	0.55	28	0.6/0.45/0.3
	TC55257BPL/BFL/BSPL-10		100	100			0.165		
	TC55257BPL/BFL/BSPL-85L		85	85					
	TC55257BPL/BFL/BSPL-10L		100	100					
1M Bit	TC551001PL/FL-85	13,1072×8	85	85	5V±10%	385	0.55	32	0.6/0.525
	TC551001PL/FL-10		100	100					

Package — P: Plastic DIP, F: Flat Package SOP, SP: Slim Plastic DIP

High-Speed Static RAM

Memory size	Type No.	Organization	Speed (ns)	Cycle time (ns)	Power supply (V)	Maximum power consumption (mW)		No. of pins	Package width (inch)	Type		
						Active	Standby					
16k bit	TMM2018AP-25	2,048 × 8	25	25	5V ± 10%	825	110	24	0.3	NMOS		
	TMM2018AP-35		35	35		743						
	TMM2018AP-45		45	45		605						
	TMM2018AP-45L		45	45								
64k bit	TC5561P/J-45	65,536 × 1	45	45	5V ± 10%	550	0.55	22/24	0.3	CMOS		
	TC5561P/J-55		55	55		550					11	
	TC5561P/J-70		70	70			550					11
	TC5562P/J-35		35	35								
	TC5562P/J-45		45	45		550	11					
	TC55416P-15H	16,384 × 4	15	15	5V ± 10%			660	5.5	22	0.3	CMOS
	TC55416P-20H		20	20		550						
	TC55416P-20		20	20	5V ± 5%	630						
	TC55416P-25		25	25	5V ± 10%	660						
	TC55416P-35		35	35		550						
	TC55417P/J-15H		15	15	5V ± 10%	660	5.5	24	0.3	CMOS		
	TC55417P/J-20H		20	20		550						
	TC55417P/J-20		20	20	5V ± 5%	630						
	TC55417P/J-25		25	25	5V ± 10%	660						
	TC55417P/J-35		35	35		550						
	TMM2088P-35		8,192 × 8	35	35	5V ± 10%	743	82.5	28	0.3	NMOS	
	TMM2088P-45	45		45	743							
	TC5588P/J-15	15		15	5V ± 10%	663	5.5	28	0.3	CMOS		
	TC5588P/J-20	20		20								
	TC5588P/J-25	25		25								
	TC5588P/J-35	35		35								
72k bit	TMM2089P-35	8,192 × 9	35	35	5V ± 10%	743	82.5	28	0.3	NMOS		
	TMM2089P-45		45	45		743						
	TC5589P/J-15		15	15	5V ± 10%	633	5.5	28	0.3	CMOS		
	TC5589P/J-20		20	20								
	TC5589P/J-25		25	25								
	TC5589P/J-35		35	35								
144k bit	※ TC55187T-20	8,192 × 18 4,096 × 8 × 2way	20	20	5V ± 10%	1265	11	52	0.75	CMOS		
	※ TC55187T-25		25	25		1210						
	※ TC55187T-30		30	30		1100						
	※ TC55188T-20		20	20		1265						
	※ TC55188T-25		25	25		1210						
	※ TC55188T-30		30	30		1100						
256K bit	※ TC55464P/J-17	65,536 × 4	17	17	5V ± 5%	630	5.5	24	0.3	CMOS		
	※ TC55464P/J-20		20	20	5V ± 10%	660						
	※ TC55464P/J-25		25	25		550						
	※ TC55464P/J-35		35	35		550						
	※ TC55465P/J-17		17	17	5V ± 5%	630	5.5	28	0.3	CMOS		
	※ TC55465P/J-20		20	20	5V ± 10%	660						
	※ TC55465P/J-25		25	25		550						
	※ TC55465P/J-35		35	35		550						
	※ TC55465P/J-17	32,768 × 8	17	17	5V ± 5%	735	5.5	28	0.3	CMOS		
	※ TC55328P/J-20		20	20	5V ± 10%	770						
	※ TC55328P/J-25		25	25		660						
	※ TC55328P/J-35		35	35		660						
288k bit	※ TC55465P/J-17	32,768 × 9	17	17	5V ± 5%	735	5.5	32	0.3	CMOS		
	※ TC55329P/J-20		20	20	5V ± 10%	770						
	※ TC55329P/J-25		25	25		660						
	※ TC55329P/J-35		35	35								

Package — P: Plastic DIP, J: SOJ
TC55417P/J: TC55416P with OE function
TC55465P/J: TC55464P/J with OE function

*: New product

EPROM

Memory size	Type No.	Organization	Maximum access time (ns)	Minimum cycle time (ns)	Power supply (V)	Operating temperature (°C)	Maximum power consumption (mW)		No. of pins	Type			
							Active	Standby					
64K Bit	TMM2764AD-15	8,192×8	150	150	5V±5%	0~70	525	158	28	NMOS			
	TMM2764AD-20		200	200									
	TMM2764AD-150		150	150	5V±10%		660	193					
	TMM2764AD-200		200	200									
128K Bit	TMM27128AD-15	16,384×8	150	150	5V±5%	0~70	525	158	28	NMOS			
	TMM27128AD-20		200	200									
	TMM27128AD-150		150	150	5V±10%		660	193					
	TMM27128AD-200		200	200									
256K Bit	TMM27256BD-15	32,768×8	150	150	5V±5%	0~70	525	158	28	NMOS			
	TMM27256BD-20		200	200									
	TMM27256BD-150		150	150	5V±10%		660	193					
	TMM27256BD-200		200	200									
	TC57256AD-12		120	120	5V±5%		158	0.525					
	TC57256AD-150		150	150	5V±10%		165	0.550					
	TC57256AD-15		150	150	5V±5%	-40~85	158	0.525					
	TC57256AD-20		200	200									
	TC57H256D-70		70	70	5V±10%	0~70	263	0.525					
	TC57H256D-85		85	85					275	0.550			
	512K Bit		TMM27512AD-17	65536×8	170	170	5V±5%	0~70	630	184	28	NMOS	
			TMM27512AD-20		200	200							
TMM27512AD-25		250	250										
TMM27512AD-200		200	200		5V±10%	715	220						
TMM27512AD-250		250	250										
TC57512AD-15		150	150		5V±5%	-40~85	158	0.525					
TC57512AD-20		200	200										
1M Bit	TC571000/1D-15	131,072×8	150	150	5V±5%	0~70	158	0.525	32	CMOS			
	TC571000/1D-20		200	200									
	TC571000/1D-200		200	200	5V±10%	-40~85	165	0.550					
	* TC57100/1D-12		120	120									
	* TC57100/1AD-85		85	85	5V±5%	0~70	210	0.525					
	TC571024D-15	65,536×16	150	150	5V±5%	0~70	210	0.525	40	CMOS			
	TC571024D-20		200	200									
	TC571024D-200		200	200	5V±10%	-40~85	220	0.550					
	* TC571024D-85		85	85							5V±5%	0~70	210
	* TC57H1024D-100		100	100									
	* TC57H1024AD-70		70	70	5V±5%	210	0.525						
	* TC57H1025AD-55		55	55									
4M Bit	* TC574000D-120		524,288×8	120	120	5V±10%	0~70	165			0.550	32	CMOS
	* TC574000D-150			150	150								
	* TC574200D-120		262,144×16	120	120	5V±10%	0~70	220			0.550	40	CMOS
	* TC574200D-150	150		150									

※: New product *: Under development

One Time PROM

Memory size	Type No.	Organization	Maximum access time (ns)	Minimum cycle time (ns)	Power supply (V)	Power consumption (mW)		No. of pins	Type	
						Active	Standby			
64K Bit	TMM2464AP/AF	8,192×8	200	200	5V±5%	525	158	28	NMOS	
128K Bit	TMM24128AP/AF	16,384×8	200	200	5V±5%	525	158	28	NMOS	
256K Bit	TMM24256BP-17/BF-17	32,768×8	170	170	5V±5%	525	158	28	NMOS	
	TMM24256BP-20/BF-20		200	200						
	TC54256AP/AF		200	200		158	0.525			CMOS
512K Bit	TMM24512AP-20/AF-20	65,536×8	200	200	5V±5%	630	184	28	NMOS	
	TMM24512AP-25/AF-25		250	250						
	TC54512AP-15/AF-15		150	150		158	0.525		CMOS	
	TC54512AP-20/AF-20		200	200						
1M Bit	TC541000/IP-15/F-15	131,072×8	150	150	5V±5%	158	0.525	32	CMOS	
	TC541000/IP-20/F-20		200	200						
	※ TC54H1024P-85	65,536×16	85	85		210	0.525			40
4M Bit	* TC544000P-20F/12	524,228×8	120	120	5V±5%	210	0.525	40	CMOS	
	* TC544000P-15/F-15		150	150						

Package — P: Plastic , F: Flat package ※: New product * : Under development

Flash E²PROM

Memory size	Type No.	Organization	Maximum access time (ns)	Minimum cycle time (ns)	Power supply (V)	Maximum power consumption (mW)		No. of pins	Type
						Active	Standby		
256K Bit	※ TC58257AP/AF-20	32,768×8	200	200	5V±10%	165	0.550	28	CMOS
	※ TC58257AP/AF-25		250	250					
	※ TC58257AP/AF-20LV (1)		200	200					
	※ TC58257AP/AF-25LV (1)		250	250					

Package — P: Plastic, F: Flat package (1) V_{PP} = 12.0V ※:New product

CMOS Mask ROM

Memory size	Type No.	Organization	Maximum access time (ns)	Minimum cycle time (ns)	Power supply (V)	Maximum power consumption (mW)		No. of pins
						Active	Standby	
256K Bit	TC53257P/F	32,768×8	150	150	5V±10%	138	0.11	28
512K Bit	TC53512CP/CF	65,536×8	150	150		193	0.11	
	TC53512CP/CF-12		120	120		220	0.11	
1M Bit	TC531000CP/CF	131,072×8	10	150		193	0.11	
	TC531000CP/CF-12		120	120		220	0.11	
	TC531001CP/CF		150	150		193	0.11	32
	TC531001CP/CF-12		120	120		220	0.11	
	TC531024P-12/15	65,536×16	150(120)	150(120)	5V±10%(5V±5%)	193(220)	0.11	40
4M Bit	TC534000P/F	524,288×8	250(200)	250(200)	5V±10%(5V±5%)	165	0.11	32
16M Bit	* TC5316200P	1,048,576×16 2,097,152×8	200	200	5V±10%	(275)	0.55	42

Package — P: Plastic DIP, F: Flat Package (SDP), 28-Pin: 450 mil, 32-Pin: 525 mil * : Under development

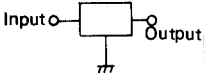
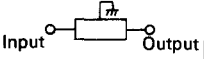
Kanji (Chinese Character) Mask ROM Series

Type No.	Type	Character dot nos.	Contents	Dot scan method	Access time	No. of chips
TC531000CP/CF-0071	CMOS	16×16	JIS C6226-1978 (1st Standard)	Row scan	150ns	1
TC531000CP/CF-0097			JIS C6226-1978 (2nd Standard)			
TC531000CP/CF-0098			JIS C6226-1983 (1st Standard)			
TC531000CP/CF-0099			JIS C6226-1983 (2nd Standard)			
TC531000CP/CF-0082~0084			JIS C6226-1978 (1st Standard)			
TC531000CP/CF-0093~0095		24×24	JIS C6226-1978 (2nd Standard)		150ns	3
TC531000CP/CF-0072~0074			JIS C6226-1978 (1st Standard)			
TC531000CP/CF-0088~0090			JIS C6226-1983 (2nd Standard)			
TC534000P/F-0051		16×16,	JIS C6226-1978 (1st Standard)	250ns	250ns	1
TC534000P/F-0053		24×24	JIS C6226-1983 (1st Standard)			

X. Power Supply Section

Power Supply ICs

Three-Terminal Regulators

Type No.	Function	Package	Characteristics		Use
			$I_{OUT}(A)$	$V_{OUT}(V)$	
TA78×××AP		TO-220AB	1	5, 6, 8, 9, 10, 12, 15, 18, 20, 24	General purpose
TA78×××S		TO-220IS	1	5, 5.7, 6, 8, 9, 10, 12, 15, 18, 20, 24	
TA78M××P		TO-220AB	0.5	5, 6, 8, 9, 10, 12, 15, 18, 20, 24	
TA78L×××AP		TO-92MOD	0.15	5, 6, 7, 7.5, 8, 9, 10, 12, 13.2, 15, 18, 20, 24	
TA78L×××F		SOT-89	0.15	5, 6, 8, 9, 10, 12, 15, 18, 20, 24	
TA78L×××S		TO-92	0.1	5, 7, 8, 9, 10, 12, 15	
TA78DL××P		TO-220AB	0.25	5, 6, 8, 9, 10, 12, 15	Low dropout
TA78DL×××S		TO-220IS	0.25	5, 6, 8, 9, 10, 12, 15	
TA78DS××P		TO-92MOD	0.03	5, 10	
TA78DS××BP		TO-92MOD	0.03	5, 6, 8, 9, 10, 12, 15	
TA79×××P		TO-220AB	-1	-5, -6, -8, -9, -10, -12, -15, -18, -20, -24	General purpose
TA79×××S		TO-220IS	-1	-5, -6, -8, -9, -10, -12, -15, -18, -20, -24	
TA79L×××P		TO-92MOD	-0.15	-5, -6, -8, -9, -10, -12, -15, -18, -20, -24	

(Note): XX and XXX indicate output voltage.

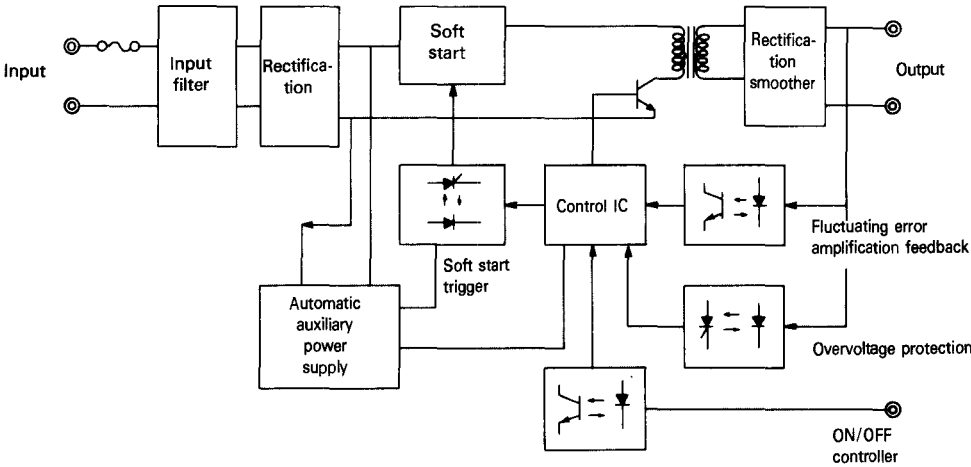
Other Regulators

Type No.	Function	Package	Characteristics	
TA7089P	Variable regulator	DIP14	$V_{OUT} = 3.3V \sim 33V$	$I_{OUT} = 0.2A$
TA7900S	With regulator watchdog timer, 5V	SIP9	$V_{IN\ MAX} = 40V$	$I_{OUT} = 330mA$
TA8000S		SIP9	$V_{IN\ MAX} = 80V$	$I_{OUT} = 300mA$
TA8001S	With regulator reset timer, 6V	SIP7	$V_{IN\ MAX} = 30V$	$I_{OUT} = 10mA$
TA8002S		SIP7	$V_{IN\ MAX} = 40V$	$I_{OUT} = 20mA$
TA7643IS	Shunt regulator	TO-92MOD	$V_{K\ MAX} = 37V$	$I_{K\ MAX} = 150mA$

Photocouplers

Fluctuation error amplification feedback	External ON/OFF control	Overvoltage protection	Soft start trigger (AC input ON/DFF)
TLP621 TLP732 TLP580	TLP621 TLP732 TLP580	TLP641G/J TLP741G/J	TLP641G/J TLP741G/J

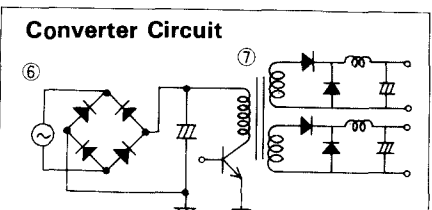
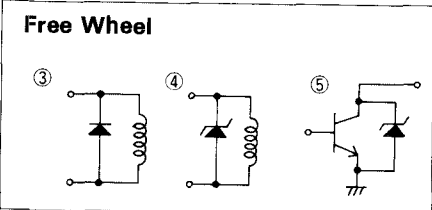
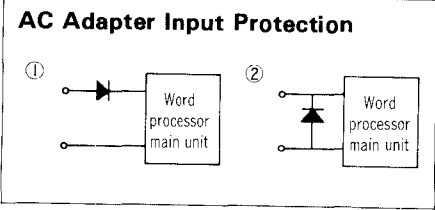
Photocoupler Equipped Power Supply: Block Diagram



Rectifier Devices and Power Transistors

Rectifier Devices

Typical Rectifier Device Application



Lineup High-Speed Secondary Rectifier Devices and Input Protection Devices (SBD)

I _o	V _{RRM}	Non-isolation type		Isolation type		Application
		30V	40V	30V	40V	
Single	1A	1FWJ42	1GWJ42			①
		1FWJ43	1GWJ43			①
		UIFWJ49	UIGWJ49			①
			UIGWJ44			①
	2A	2FWJ42	2GWJ42			①
	3A	3FWJ42	3GWJ42			①
C/T	5A	5FWJ2C42	5GWJ2C42	5FWJ2CZ42	5GWJ2CZ42	⑦
	10A	10FWJ2C42	10GWJ2C42	10FWJ2CZ42	10GWJ2CZ42	⑦

High-Speed Secondary Rectifier Devices (High-Efficiency Diode: HED)

I _o	V _{RRM}	Non-isolation type			Isolation type		Applica- tion
		100V	150V	200V	150V	200	
Single	1A	IBL41/42	ICL41/42	IDL41/42			⑦
			UICL49	UIDL49			② ⑦
	1.5A	IR5BL41	IR5CL41	IR5DL41			⑦
	3A	3BL41	3CL41	3DL41			⑦
	5A		5CL2C41A	5DL2C41A	5CL2CZ41A	5DL2CZ41A	⑦
	10A		10CL2C41A	10DL2C41A	10CL2CZ41A	10DL2CZ41A	⑦

DC-DC Converters (Bipolar Transistors)

Type No.	I _c (A)	V _{CE0} (V)	P _c (W) (T _c =25°C)	V _{CE(sat)} (V) MAX	Package	
2SC3225	2	40	0.9*	0.5	TO-92MOD	
2SC2655		50				
2SC3328		80				
2SC3076	2	50	10	0.5	Power mold	
2SC3474		80	20			
2SC3074	5	50		0.4		
2SC3303		80				
2SC2562	5	50	25	0.4	TO-220AB	
2SC3258		80	30			
2SD553	7	50	40	0.5		
2SD843		80				
2SC3345	12	50		0.4		
2SC3346		80				
2SC3475	4	60	20	0.6	TO-220 (IS)	
2SC3299	5	50		0.4		
2SD1412	7	80	30	0.5		
2SD1411		50		0.4		
2SC3709	12	80				0.4
2SC3710		50				

* : T_a = 25°C

Surge Absorber (Zener Diode)

P _w	Type No.	Application
1W	1AZ6.8 ~ 1AZ51	④ ⑤
	1Z6.8 ~ 1Z390	
	1ZB6.8 ~ 1ZB51	
	UIZB12 ~ UIZB51	
1.5W	2Z12 ~ 2Z51	④ ⑤
3W	3Z12 ~ 3Z51	④ ⑤

AC-DC Converter and Surge Absorber (General-Purpose Rectifier Device)

I _o	V _{RRM}	100V	200V	400V	Application
Single	1A	S5566B		S5566G	② ③ ⑥
		S5688B		S5688G	② ③ ⑥
		UIBC44		UIGC44	② ③ ⑥
	1.5A	IR5BZ41	IR5DZ41	IR5GZ41	② ③ ⑥
Bridge	3A	3BZ41	3DZ41	3GZ41	② ③ ⑥
	0.5A	OR5B4B48	OR5D4B48	OR5G4B48	⑥
	1A	1B4B41	1D4B41	1B4B41	⑥
		1B4B42	1D4B42	1G4B42	⑥

DC-DC Converters (Power MOS FET)

Type No.	I _D (A)	V _{DSS} (V)	P _D (W)	R _{DS} (ON) (Ω) Typ.	Package
2SK672	10	60	40	0.15	TO-220AB
2SK673	15		100	75	
2SK888		0.14			
2SK674	25	60	100	0.04	TO-220 (IS)
2SK1346			40		
2SK889	27	100	125	0.07	TO-220AB
2SK850	35		150	0.045	TO-3P (N)
2SK849	40	0.029			
2SK856	45	60	125	0.022	TO-220AB
2SK1124					TO-3P (N)

DC-DC Converters (L²-π-MOS III Series)

Type No.	I _o	V _{DSS} (V)	P _o (W)	R _{DS(ON)} (Ω) Typ.		Package
				@ 10V	@ 4V	
2SK1079	0.6	100	0.5	0.95	1.2	Power mini
2SK941			0.9			TO-92MOD
2SK1078	0.8	60	0.5	0.4	0.75	Power mini
2SK940			0.9			TO-92MOD
2SK1113	3	120	20	0.33	0.4	Power mold
2SK1112	5	60		0.12	0.2	
2SK1114	12	60	40	0.055	0.088	TO-220AB
2SK1344			30			TO-220 (IS)
2SK1115	20	100	60	0.042	0.064	TO-220AB
2SK1345			40			TO-220 (IS)
2SK942	25	60	75	0.036	0.07	TO-220AB
2SK943			40			TO-220 (IS)
2SK1116		100	100	0.045	0.07	TO-220AB
2SK1349			45			TO-220 (IS)

XI. Other Main ICs

CMOS Logic ICs

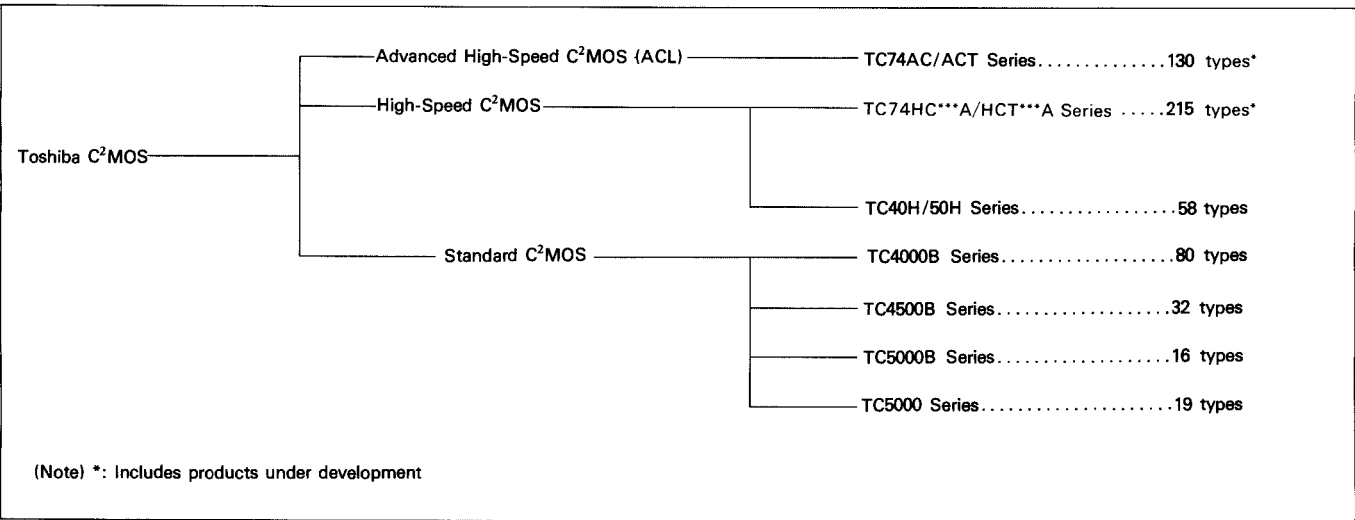
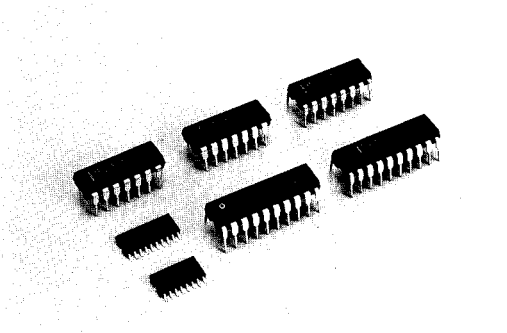
C²MOS Logic Family

CMOS standard logic ICs are used in a wide range of consumer and industrial products because of their outstanding characteristics such as low power consumption, wide operating range and high noise immunity. Recent improvements in integration technology have led to a high-speed CMOS series (TC74HC, TC74AC) that compete with high-speed bipolar logic ICs. Much is expected from these series in fields such as communications that require high-speed operation.

Toshiba offers a varied C²MOS family lineup, from the standard type to the most advanced high-speed type, to meet the diverse needs of users. Also, the development of Mini-Flat packages assists in making the equipment in which they are used more compact and lightweight.

Features

- Low power consumption: $P_D = 0.01\mu W$ (standby)
- High noise immunity
- Wide operating voltage range: 3 to 18V (TC4B*** Series)
2 to 6V (TC74HC***A Series)
2 to 5.5V (TC74AC Series)
- Wide operating temperature range: $T_{OPR} = -40$ to $85^\circ C$
- Wide lineup
- High quality, high reliability



Comparison of Logic Family Characteristics

Item	Symbol	TC74AC*** Series	TC74HC*** Series	TC40H*** Series	TC4 ***B Series	Unit	Conditions
Propagation delay time (Gate)	tpLH tpHL	3.5	6	15	65	ns	V _{CC} = 5V C _L = 15pF T _a = 25℃
Maximum clock frequency (F/F)	f _{MAX}	150	80	20	8	MHz	
Quiescent power dissipation (Gate)	P _D	0.01μ	0.01μ	0.01μ	0.01μ	W	V _{CC} = 5V All temperature range
Noise immunity	V _{IH}	3.5*	3.5*	4.0	3.5	V	
	V _{IL}	1.5*	1.5*	1.0	1.5		
Output current (standard output)	I _{OH}	−24	−4.0	−0.36	−0.42	mA	V _{CC} = 4.5V
	I _{OL}	24	4.0	0.8	0.42		
Operating power supply voltage	V _{DD}	2~5.5**	2~6**	2~8	3~18	V	
Operating temperature	T _{OPR}	−40~85	−40~85	−40~85	−40~85	℃	

*: V_{IH} and V_{IL} in HCT/ACT series are 2.0V and 0.8V, respectively.
**: HCT/ACT series ranges from 4.5 to 5.5V.

Bi-CMOS Logic

TD74BC Series

How to combine low power-consumption characteristics of C₂MOS with high-load drive capability? Toshiba has found the answer through original and imaginative technology.

The TD74BC Series are remarkable devices that utilize the most advanced Bi-CMOS technology to achieve a great improvement in the bus interface performance of digital systems. The high-speed performance and high-load drive capability of the series are compatible with the FAST Series. Moreover, introduction of CMOS circuits greatly reduces power consumption during operation and disable.

Toshiba will expand the lineup while placing octal-bus devices among the major products in the series.

- High-speed operation
- High drive capability: Output stage is configured with bipolar equivalent to FAST*.
High drivability of 48mA type.
- Low power consumption: Same level as CMOS during disable; lowest in the high-speed logic ICs when 5MHz or above during operation.

Application	System bus for personal and mini computers; OA equipment; measuring equipment; battery-use equipment.
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※FAST is a trademark of National Semiconductor Corporation

Bi-CMOS Logic TD74BC Family

Type No.	Package	Function
TD74BC00P	DIP 14	QUAD 2-INPUT NAND GATE
TD74BC08P	DIP 14	QUAD 2-INPUT AND GATE
TD74BC32P	DIP 14	QUAD 2-INPUT OR GAOE
TD74BC230P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS BUFFER
TD74BC231P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS BUFFER
TD74BC240P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS BUFFER
TD74BC241P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS BUFFER
TD74BC242P	DIP 14	QUAD BUS TRANSCEIVER
TD74BC243P	DIP 14	QUAD BUS TRANSCEIVER
TD74BC244P/F/FW	DIP 20/SOP 20/SOL 20	OCTAL BUS BUFFER
TD74BC365P	DIP 16	HEX BUS BUFFER
TD74BC366P	DIP 16	HEX BUS BUFFER
TD74BC367P	DIP 16	HEX BUS BUFFER
TD74BC368P	DIP 16	HEX BUS BUFFER
TD74BC373P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL TRANSPARENT LATCH
TD74BC374P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL D-TYPE FLIP-FLOP
TD74BC533P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL TRANSPARENT LATCH
TD74BC534P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL D-TPE FLIP-FLOP
TD74BC540P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS BUFFER
TD74BC541P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS BUFFER
TD74BC563P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL TRANSPARENT LATCH
TD74BC564P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL D-TYPE FLIP-FLOP
TD74BC573P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL TRANSPARENT LATCH
TD74BC574P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL D-TYPE FLIP-FLOP
TD74BC575P	DIP 24	OCTAL D-TYPE FLIP-FLOP
TD74BC620P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS TRANSCEIVER
TD74BC623P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS TRANSCEIVER
TD74BC640P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS TRANSCEIVER
TD74BC643P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS TRANSCEIVER
TD74BC645P/F /FW	DIP 20/SOP 20/SOL 20	OCTAL BUS TRANSCEIVER

TTL, (FAST, LSTTL)

LSTTL is widely accepted in the TTL market. FAST is a high-performance TTL family which is constructed by employing a device isolation technique using oxide films.

Through cooperation with Motorola, Toshiba provides the LSTTL Family (99 types) and high-speed FAST Family (43 types) as an OEM of Motorola.

LS & FAST Series Naming

SN74LS Series is the low power Shottky TTL. MC74F Series is the FAST Series.
The official namings are as follows.

•LS Series SN74LS

•FAST Series MC74F

Package classification

Function classification

N: Plastic DIP
NH: Plastic DIP 20 (Half lead)

“FAST” is a registered trademark of National Semiconductor Corporation

Comparison of the Characteristics of LS and FAST (Typical Characteristics)

Characteristics	Symbol	LS	FAST	Unit
Static current consumption per gate	I_G	0.4	1.1	mA
Static power consumption per gate	P_G	2.0	5.5	mW
Carrier delay time	t_P	9.0	3.7	ns
Speed power accumulation	—	18	19.2	pJ
Clock frequency (D-FF)	f_{max}	33	125	MHz
Clock frequency (counter)	f_{max}	40	125	MHz

Test conditions: $V_{CC} = 5.0V$, $T_a = 25^{\circ}C$, $C = 15pF$ (LS) and $50pF$ (FAST)

Electrical Characteristics

Characteristics	Symbol	Test conditions	LS			FAST			Unit
			MIN	TYP	MAX	MIN	TYP	MAX	
Power supply voltage	V_{CC}		4.75		5.25	4.5		5.5	V
Operating temperature	T_{opr}		0		70	0		70	$^{\circ}C$
High-level input voltage	V_{IH}		2.0			2.0			V
Low-level input voltage	V_{IL}				0.8			0.8	V
High-level input current	I_{IH}	$V_{CC}-MAX$ $V_{IN}=2.7V$			20			20	μA
Low-level input current	I_{IL}	$V_{CC}-MAX$ $V_{IN}=0.5V$			-0.4			-0.6	mA
High-level output current	I_{OH}	$V_{CC}=4.75V$ $V_{OH}=2.7V$	-0.4			-1.0			mA
Low-level output current	I_{OL}	$V_{CC}-MIN$ $V_{OL}=0.5V$	8.0			20			mA

Switching Characteristics (Typical Products) D-FF LS744A, F74

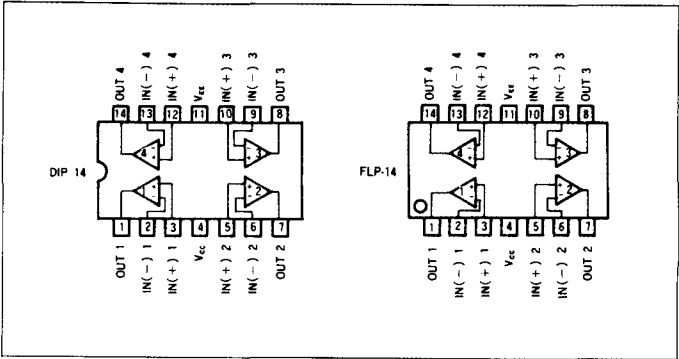
Characteristics	Symbol	74LS74A LS			74F74 FAST			Unit
		MIN	TYP	MAX	MIN	TYP	MAX	
Carrier delay time $CP_n \cdot Q_n \overline{Q_n}$	t_{PHL} t_{PHL}		13 25	25 40	3.8 4.4	5.3 6.2	6.8 8.0	ns
Carrier delay time $CD \cdot SD \cdot \overline{Q_n} \overline{Q_n}$	t_{PLH} t_{PHL}		13 25	25 40	2.5 3.5	4.6 7.0	6.1 9.0	ns
Maximum clock frequency	f_{MAX}	25	33		100	125		MHz
Maximum pulse width CP_n	$t_w(L)$ $t_w(H)$	— 25			4.0 5.0			ns
Minimum pulse width $\overline{CD_n}$, $\overline{SD_n}$	$t_w(L)$	25 25			4.0			ns
Minimum setup time	$t_s(H)$ $t_s(L)$	20 20			2.0 3.0			ns
Minimum hold time	$t_h(H)$ $t_h(L)$	5.0 5.0			1.0 1.0			ns
Recovery time $\overline{CD_n}$, $\overline{SD_n}$, CP	t_{rec}	—			2.0			ns

Op Amps, Comparators, Transistor Arrays

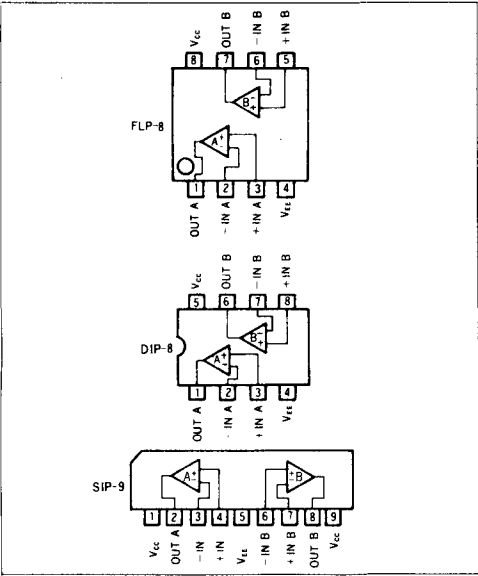
Op Amps

Classification	Type No.	Package	Remarks
Dual op amps	TA75458P	DIP-8	General purpose, NPN input
	TA75458S	SIP-9	
	TA75458F	FLP-8	
	TA75358CP	DIP-8	General purpose, PNP input
	TA75358CF	FLP-8	
	TA75557P	DIP-8	Low noise, high output current
	TA75557S	SIP-9	
	TA75557F	FLP-8	
Dual op amps	TA75558P	DIP-8	Low noise
	TA75558S	SIP-9	
	TA75558F	FLP-8	
	TA75559P	DIP-8	Low noise, wide band
	TA75559S	SIP-9	
Quad op amps	TA75902P	DIP-14	General purpose, PNP input
	TA75902F	FLP-14	

Quad Op Amp Pin Connections



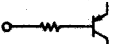
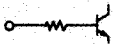
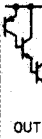
Dual Op Amp Pin Connections



Dual Comparators

Type No.	Package	Remarks
TA75393P	DIP-8	General purpose
TA75393S	SIP-9	
TA75393F	FLP-8	

Transistor Arrays

		LOW LEVEL INPUT ACTIVE		HIGH LEVEL INPUT ACTIVE				
		INPUT 		INPUT 				
OUTPUT (SINK)	LOW SAT 	0.1		TD62382AP	TD62551S ↓ TD62555S	TD62501P ↓ TD62507P TD62301P TD62302P TD62306P TD62307P	TD62583AP	
		0.5		TD62383P		TD62303P TD62309P	TD62381P	
		1.0	* TD62400AP					
	DARLINGTON 	0.1				TD62006P TD62007P		
		0.5	TD62304P TD62305P	TD62384AP TD62385AP		TD62001P ↓ TD62004P TD62008AP TD62101P ↓ TD62105P	TD62081AP ↓ TD62084AP	
		1.0	TD62308AP/ BP		TD62064P/ AP/ BP TD62074P/ AP TD62107P/ BP			
	LOW SAT 	0.1		TD62703P		TD62705P TD62706P		
		0.5		TD62785P				
		1.0						
		DARLINGTON 	0.1					TD62781AP TD62782AP
			0.5		TD62786AP TD62787AP			TD62783AP TD62784AP
			1.0					
			4	5~7	8	4	5~7	8
		Channel			Channel			

*: Under development
TD62XXXP Series T_{OP} $V_{CE(SAT)}$
TD62XXXAP Series $-30 \sim 75^{\circ}\text{C}$ $\sim 35\text{V}$
TD62XXXBP Series $-40 \sim 85^{\circ}\text{C}$ $\sim 50\text{V}$
TD62XXXBP Series $-40 \sim 85^{\circ}\text{C}$ $\sim 80\text{V}$

XII. Other Discrete Devices

General-purpose Small Signal Transistors

Type No. under package classification								V _{CE0} (V)	I _c (mA)
TO-92		MINI		S-MINI		USM			
PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN		
—	2SC2878	—	2SC3327	—	2SC3326	—	2SC4213	20	300
2SA1296	2SC3266	2SA1297	2SC3267	—	—	—	—	20	2000
2SA562TM	2SC1959	—	—	2SA1182	2SC2859	2SA1588	2SC4118	30	500
2SA950	2SC2120	2SA1150	2SC2710	2SA1621	2SC4210	—	—	30	800
2SA1015	2SC1815	2SA1048	2SC2458	2SA1162	2SC2712	2SA1586	2SC4116	50	150
—	2SC3112	—	2SC3113	—	2SC3295	—	—	50	150
(2SA970)	(2SC2240)	2SA1049	2SC2459	2SA1163	2SC2713	2SA1587	2SC4117	120	100

Bias Resistor Transistors (BRT)

Polarity	V _{CE0} = 50V, I _c = 100mA				V _{CE0} = 50V, I _c = 800mA	
	TO-92	MINI	S-MINI	USM	MINI	S-MINI
NPN	RN1001 Series	RN1201 Series	RN1401 Series	RN1301 Series	RN1221 Series	RN1421 Series
PNP	RN2001 Series	RN2201 Series	RN2401 Series	RN2301 Series	RN2221 Series	RN2421 Series

Small Signal Diodes (Surface Mount Type)

Type No.	Application	Electrical Characteristics (T _a = 25°C)				Mark	Similar types	Remarks
		V _R (V)	I ₀ (mA)	t _{rr} (ns)	Internal connection			
ISS181	High-speed switching	80	100	1.6TYP		A3	IS1585	Anode common
ISS184	High-speed switching	80	100	1.6TYP		B3	IS1585	Cathode common
ISS187	High-speed switching	80	100	1.6TYP		D3	IS1585	Single
ISS190	High-speed switching	80	100	1.6TYP		E3	IS1585	Single
ISS193	High-speed switching	80	100	1.6TYP		F3	IS1585	Single
ISS196	High-speed switching	80	100	1.6TYP		G3	IS1585	Single
ISS226	High-speed switching	80	100	1.6TYP		C3	IS1585	Series
ISS250	High-voltage, high-speed switching	200	100	30TYP		F5	ISS247	Single
ISS272	High-speed switching	80	100	1.6TYP		A1	IS1585	Double
ISS306	High-voltage, high-speed switching	200	100	30TYP		A3	ISS247	Single
ISS307	Low leak current	30	100	—		C9	ISS104	Single
ISS308	High-speed switching	80	100	1.6TYP		A1	IS1585	Anode common
ISS309	High-speed switching	80	100	1.6TYP		A2	IS1585	Cathode common
ISS311	High-speed switching	400	100	1.5μsTYP		B9	—	Single

General-purpose Schottky Barrier Diodes

Type No.	V _R (V)	I ₀ (mA)	P (mW)	Package
1SS293	40	100	300	MINI
1SS294	40	100	150	S-MINI
1SS319	40	100	150	SMQ
1SS321	10	50	150	S-MINI
1SS322	40	100	100	USM

Zener Diodes

Type No.	Allowable power dissipation	Zener Voltage (V)
02CZ Series	200mW	2 ~ 47
04AZ Series	400mW	2 ~ 39
05AZ Series	500mW	2.2 ~ 100
02BZ Series	250mW	2.2 ~ 4.7

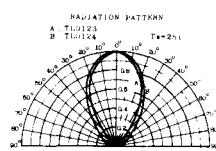
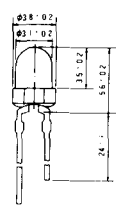
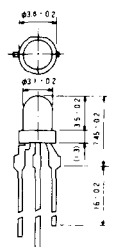
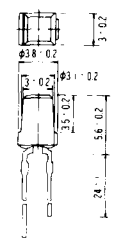
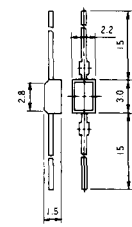
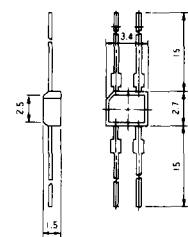
L-MOS (1 Gate CMOS) Series

		NAND	AND	NOR	OR	INV	INV(UB)
Circuit diagram (Top view)							
TC4S Series	Device name	TC4S11F	TC4S81F	TC4S01F	TC4S71F	TC4S69F	TC4SU69F
	Mark	C1	C2	C3	C4	C5	C6
	Equivalent device	TC4011B	TC4081B	TC4001B	TC4071B	—	TC4069UB
TC7S Series*	Device name	TC7S00F	TC7S08F	TC7S02F	TC7S32F	TC7S04F	TC7SU04F
	Mark	E1	E2	E3	E4	E5	E6
	Equivalent device	TC74HC00	TC74HC08	TC74HC02	TC74HC32	TC74HC04	TC74HCU04

Circuit diagram (Top view)					
Function		NAND (UB)	EX-OR	Analog SW	Schmitt Trigger
TC4S Series (expanded type)	Device name	TC4SU11F	TC4S30F	TC4S66F	TC4S584F
	Mark	C7	C8	C9	CA
	Equivalent device	TC4011B	TC4030B	TC4066B	TC4584B

*I_{OH} and I_{OL} are 1/2 that of the TC74HC Series.

LED Lamp Series

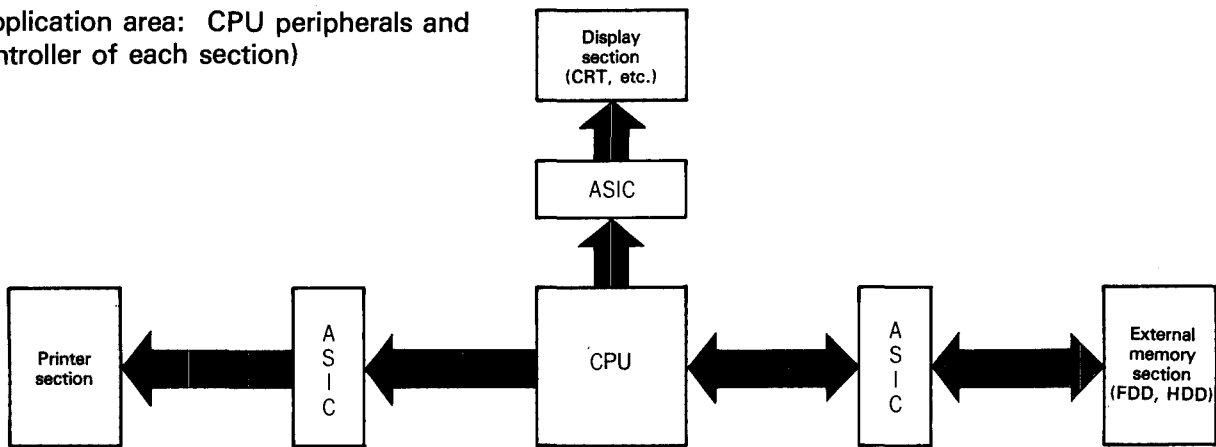
Appearance	Type No.	Color symbol Lens	Green				Yellow	Orange	Red				Features	Outline
			PG	G	Y	O	R	S	UR	RC				
	TLG123A TLY123 TLO123 TLR123 TLS123 TLUR123 TLRC123	Colored clear		○	○	○	○	○	○	○	○	Directional characteristic A: 123, 125 B: 124 		
	TLG124A TLY124 TLO124 TLR124 TLS124 TLUR124 TLRC124	Colored diffused		○	○	○	○	○	○	○	○			
	TLRC125	Colorless clear												○
	TLSG126	Milky white diffused		○						○		$\phi 3$ Red/green 2-color type 		
	TLPG209 TLG209 TLY209 TLR209	Colored diffused	□	□	□				□			3×3 		
	TLG221 TLY221 TLO221 TLR221 TLS221 TLRC221	Light colored clear		□	□	□	□	□	□		□	1.7×2.5 Reflection plate built- in high-efficiency type Small package, wide radiation For backlighting 		
	TLSG222	Colorless clear		□					□			2.2×2.9 Red/green 2-color type Reflection plate built- in high-efficiency type Small package, wide radiation For backlighting 		

XIII. ASIC - Application Specific IC

There is a great variety of products on the market today. And yet there is still a demand for higher performance, more functions and greater miniaturization. ASICs have attracted a great deal of attention as a means of satisfying these needs. Toshiba ASICs are capable of implementing large-amount logic (high integration and miniaturization) without using standard LSI's. Operating speeds equivalent to those of ECL are also possible.

Typical System Configuration

(Application area: CPU peripherals and controller of each section)



Development Flow and Customer Interface

Development flow		Logic design	Schematic entry	Design verification	Functional and timing simulation	Node coverage verification	Auto placement & routing	Re-simulation	PG & MASK tooling
Interface level	Level 1	Customer							
	Level 2 ⁽¹⁾			Customer (Toshiba tool)					
	Level 3 ⁽²⁾			Customer (customer tool)					
	Level 4			Customer					

Level 1: The customer submits the schematic of his or her design and we are in charge of the later design works.
Level 2: The customer sets up the netlist and the test data and with assistance of our staff, performs a simulation on the Toshiba mainframe CAD system in the Toshiba LSI Design Center.
Level 3: The customer performs initial steps of simulations on his or her EWS. We complete the following design process.
Level 4: The customer performs a simulation and creates calma format of mask data. Only we have to do is customize masks.

Toshiba ASIC Series and EWS Support⁽¹⁾

ASIC Family	Gate Arrays				Standard Cells	
	TC17G	TC110G	TC120G	TC140G	TC23SC	TC24SC
VLCAD™	—	★	★	★	★	★
IDEA	★	★	★	●	★	★
LOGICIAN	★	★	★	★	★	●
SCALDsystem	★	★	★	●	★	●
HP EDS	★	★	★	●	●	●
AIDA	—	★	★	●	—	—
WORKVIEW	★	★	★	★	★	★
DASH ⁽²⁾	★	★	★	●	●	●
HILO	★	★	★	●	●	●
IKOS	—	★	★	●	★	●

(1) Simulation speed and gate count that can be handled depend on the EWS and its hardware configuration.
Please ask us in advance of actual planning development for detailed technical information.

(2) DASH supports only schematic entry and TDL netlist creation.

As of Nov., 1989
Symbols : ★ Full-support
●: Under development

Trademarks

- VLCAD is a trademark of Toshiba Corporation.
- IDEA Series is a trademark of Mentor Graphics Corporation.
- LOGICIAN is a trademark of DAISY/CADNETIX Inc.
- SCALD system is a trademark of Valid Logic Systems Incorporated.
- AIDA is a trademark of TERADYNE Corporation.

- Workview is a trademark of Viewlogic Systems Incorporated.
- DASH is a trademark of FutureNet Corporation.
- HILO is a trademark of GenRad Corporation.

Gate Arrays

The CMOS gate arrays are the result of the integrated power generated by Toshiba's original HC²MOS and VLSI technologies. The gate complexity ranges from 540 to 68,000. The Sea of Gate type gate arrays TC110G/TC120G/TC140G Series are available to satisfy customer requirements for higher density and speeds.

	TC17G Series ⁽²⁾	TC110G Series ⁽²⁾	TC120G Series	TC140G Series
Gate complexity	540~10K	1400~50K ⁽³⁾	15K~50K ⁽³⁾	1000~68K ⁽³⁾
Design rule	2μm	1.5μm	1.0μm	1.0μm
Gate speed (inner gate, typ.)	1.5ns	0.6ns	0.4ns	0.4ns
Application	STTL	ASTTL/ECL	ECL	ECL

(Note)

(1) Can be mounted on the TC110G/TC120G/TC140G product.

(2) Alternately-sourced by LSI Logic Corp.

(3) Based on 40% array utilization.

(4) Released as they are ready.

Building-block memory⁽¹⁾

•Single/triple port RAM (Max. 4.5K)

•ROM (Max. 16K)

Megacell, megafunction⁽¹⁾⁽⁴⁾

•ALU, CLA, MPY, Barrel shifter, FIFO

•2900 family

•CPU peripheral

Standard Cells

These are pre-designed building-block-type standard cells which can be combined to form a variety of systems on one chip. Large ROM and RAM cells can be incorporated to create ultrahigh-level function LSIs.

	TC23SC Series	TC24SC Series	TC23SB Series ⁽⁵⁾
Gate complexity (Max.)	50K	70K	50K
Gate speed (inner gate, typ.)	1.0ns	0.65ns	1.0ns
Design rule	1.5μm	1.0μm	1.5μm
Library ⁽⁵⁾	RAM, ROM MPY, FIFO ADDER, ALU, Barrel shifter 2900 Series-compatible cell, CPU peripheral Analog cell 74HC Series-compatible cell		Output buffer Open-collector buffer 3-state buffer Clock buffer ECL-interface input ECL-interface output

(Note) (5) Released in order

(6) Bi-CMOS

Custom IC

Super Integration (SI)

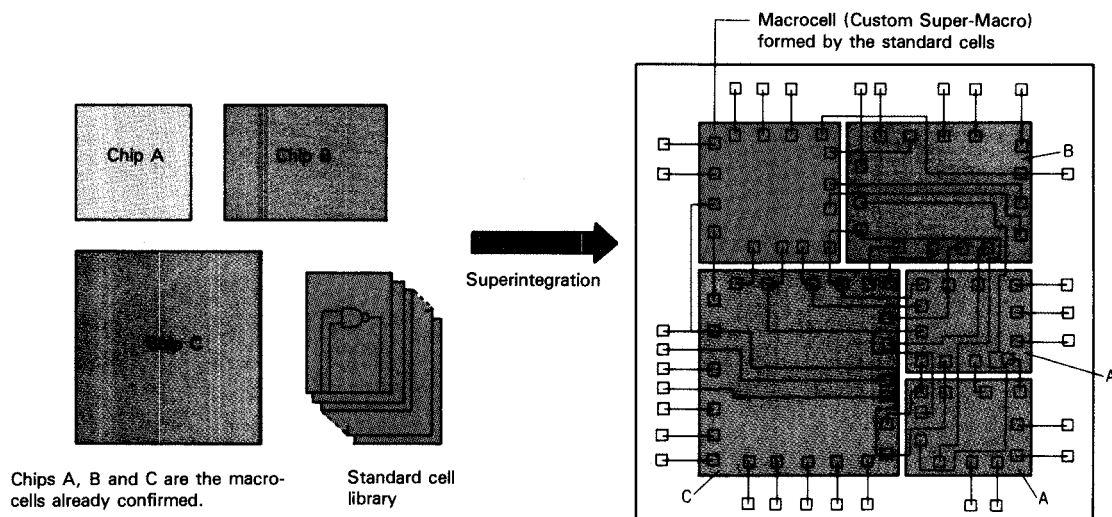
Super Integration technology enables us to develop an LSI with your own circuit image.

Super Integration is a custom LSI technology which, using the existing CPU and peripheral LSI as a basic design cell, adds the logic circuits particular to a customer-designed system, and integrates them on one chip in a short period of time.

Through utilizing this technology, development of an LSI can be similar to the design concept for the PCBs for various systems with large scales and through making the best use of the features of CMOS and VLSI technology, it enables the system to be more compact and higher in performance.

Configuration of Super Integration

After forming already-developed LSIs A, B and C and a custom super-macrocell configured with the standard cell of logic circuits particular to a customer-designed system, each cell is connected by the 2-layer metal wires. This enables us to develop high-precision LSI in a short period of time.



Macrocell Library

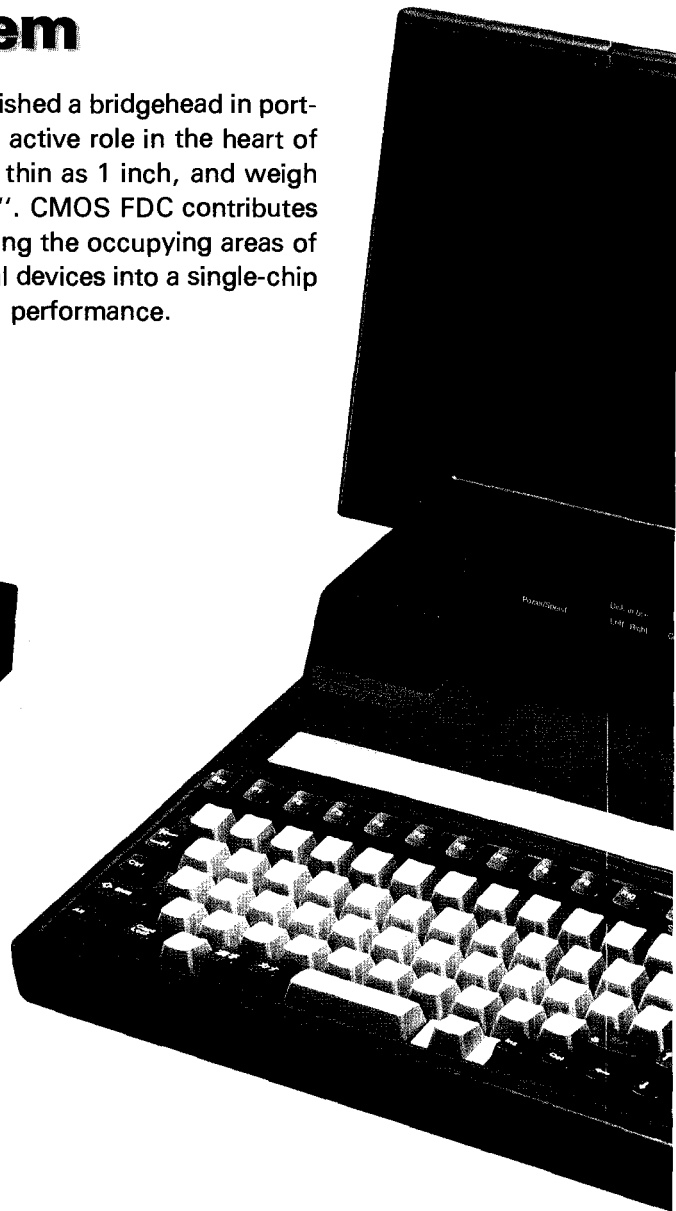
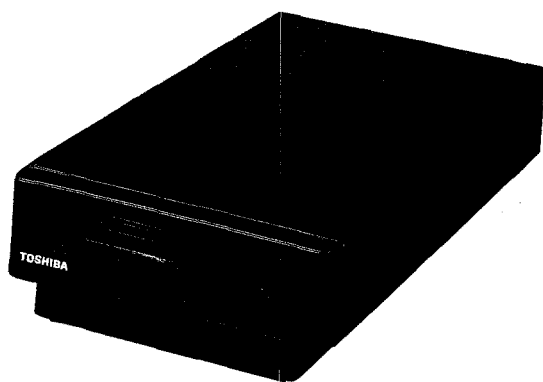
As a $1.5\mu/1.2\mu$ -rule macrocell that utilizes Toshiba's CMOS, VLSI technologies, products in () are available.

MACRO CELL FAMILY($1.5\mu/1.2\mu$)

No.	Cell	Function		
1	CPU	(TMPZ84C00A Compatible)	13	CPC (TC8576A:Combination Peripheral Controller)
2	DMA	(TMPZ84C10A Compatible)	14	RTC (TC8521A Compatible)
3	Parallel I/O	(TMPZ84C20A Compatible)	15	CRTC (TC8505A Compatible)
4	Counter/Timer	(TMPZ84C30A Compatible)	16	UART (TC8570A Compatible)
5	Serial I/O	(TMPZ84C40A Compatible)	17	LCDC & CRTC (T7779 Compatible)
6	DMA	(TMP82C37A Compatible)	18	LCDC (T6963 Compatible)
7	PCI	(TMP82C51A Compatible)	19	VDP (T6950 Compatible)
8	PIT	(TMP82C53 Compatible)	20	PSG (T7766 Compatible)
9	PIT	(TMP82C54 Compatible)	21	A/D (TC35094:8Bit 1Ch 19μ s Succ. Approx.)
10	PPI	(TMP82C55A Compatible)	22	A/D (TC35095:8Bit 8Ch 35μ s Succ. Approx.)
11	PIC	(TMP82C59A Compatible)	23	Flash A/D (6.8Bit 20MHZ)
12	FDC	(TC8565A Compatible)	24	RAM
			25	ROM

Floppy Disk System

Battery-drive FDDs and CMOS FDC established a bridgehead in portable word processors, and they also play an active role in the heart of laptop PCs. 3.5-inch FDDs have become as thin as 1 inch, and weigh less than 300g; they are indeed the "laptops". CMOS FDC contributes in making the equipment smaller by decreasing the occupying areas of internal PCBs through gathering all peripheral devices into a single-chip FDC, and longer life batteries enable higher performance.



Memory IC

1M-bit pseudo static RAMs and 256K-bit static RAMs are the key components that answer to the memory needs of the 16-bit CPU system without losing its compactness and without increasing power consumption.

For Japanese word processing, large-scale ROMs are needed for Kanji fonts and dictionaries and the 4M-bit CMOS ROMs solved this problem.

The age of 4M-bit pseudo static RAMs and 16M-bit CMOS ROMs is close at hand.

Display Section

LCD displays are most appropriate for battery-drive laptop computers.

Large-size 640 x 400 dot-matrix LCDs are becoming to be the mainstream to provide the same performance as the 16/32-bit desk-top computers. More than 10 LSIs are used for the LCD panel drive. An LCD control/driver IC sealed in a multi-pin flat package enables thin and light weight display panels.

The use of STN-type LCDs solved the problem of display grades and the appearance of color displays are awaited for laptop PCs. Color displays for use in laptops are expected to cover the gap which exists between desk-top CRTs.

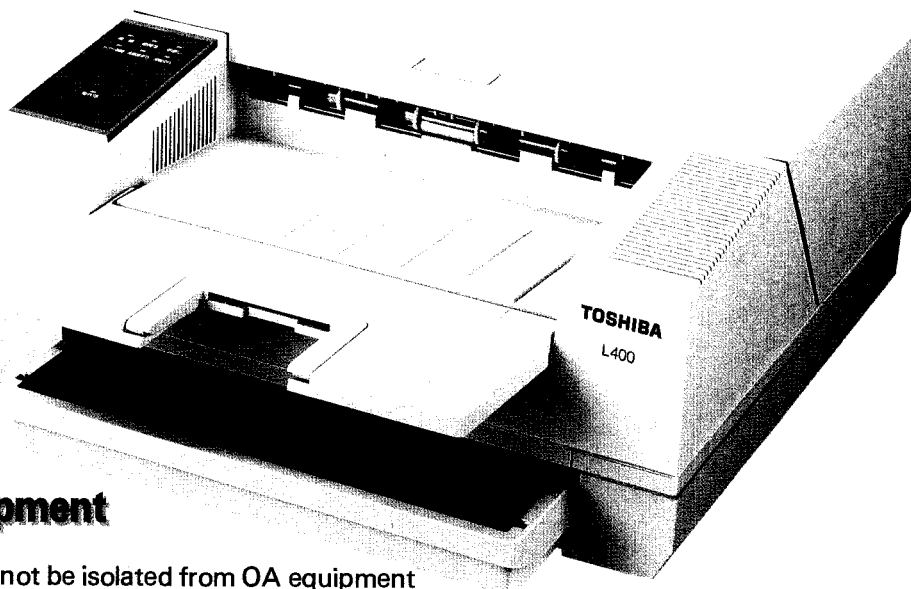
Hard Disk System

Compact HDDs enabled laptop PCs to be as highly functional as the workstations. The trend of the HDDs is toward battery drive.

3.5-inch HDDs, like FDDs, are becoming to be only 1 inch thick, and weighing like FDDs. Low power consumption and higher performance are possible by the use of HDC LSIs.

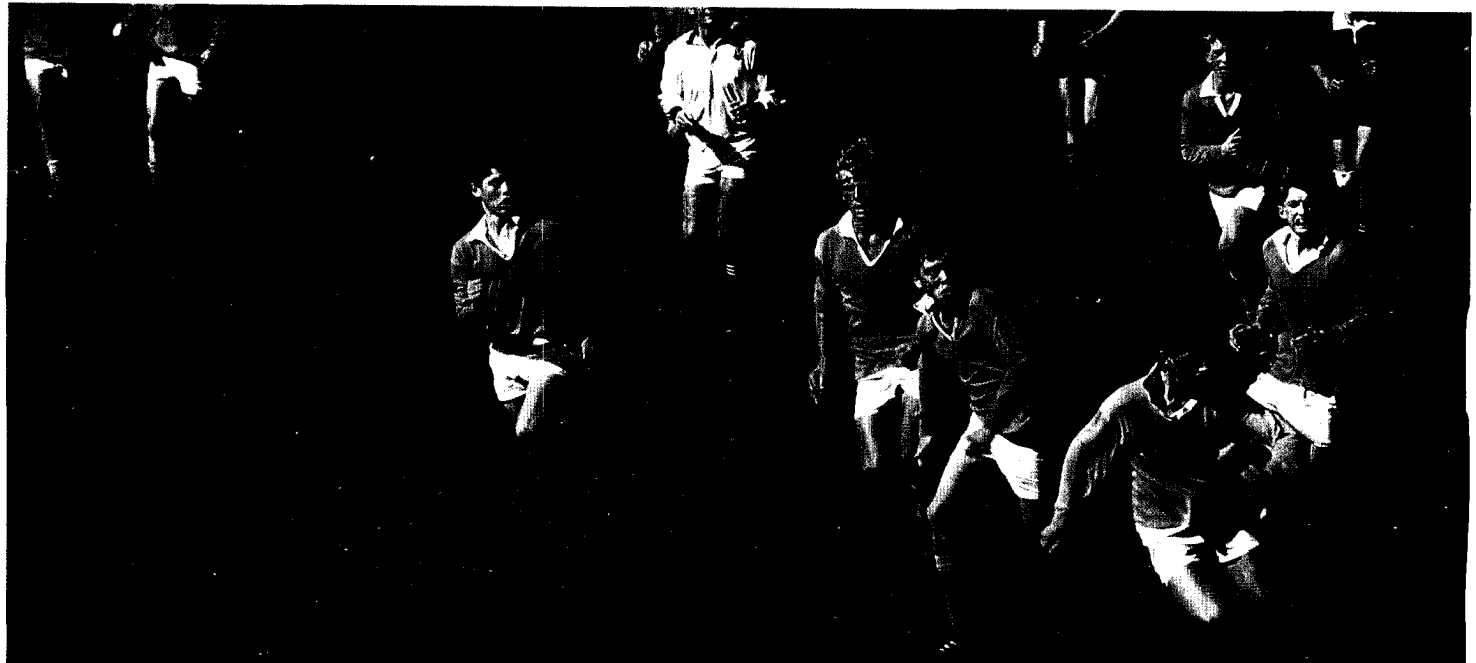
Only one recording media can be built in due to its thinness but it can hold a 40M-byte capacity supported by the RLL27 code magnetic recording method to improve magnetic recording density.

HDD's capacity is now expanding to 100M-bytes by improving the speed of data transfers.

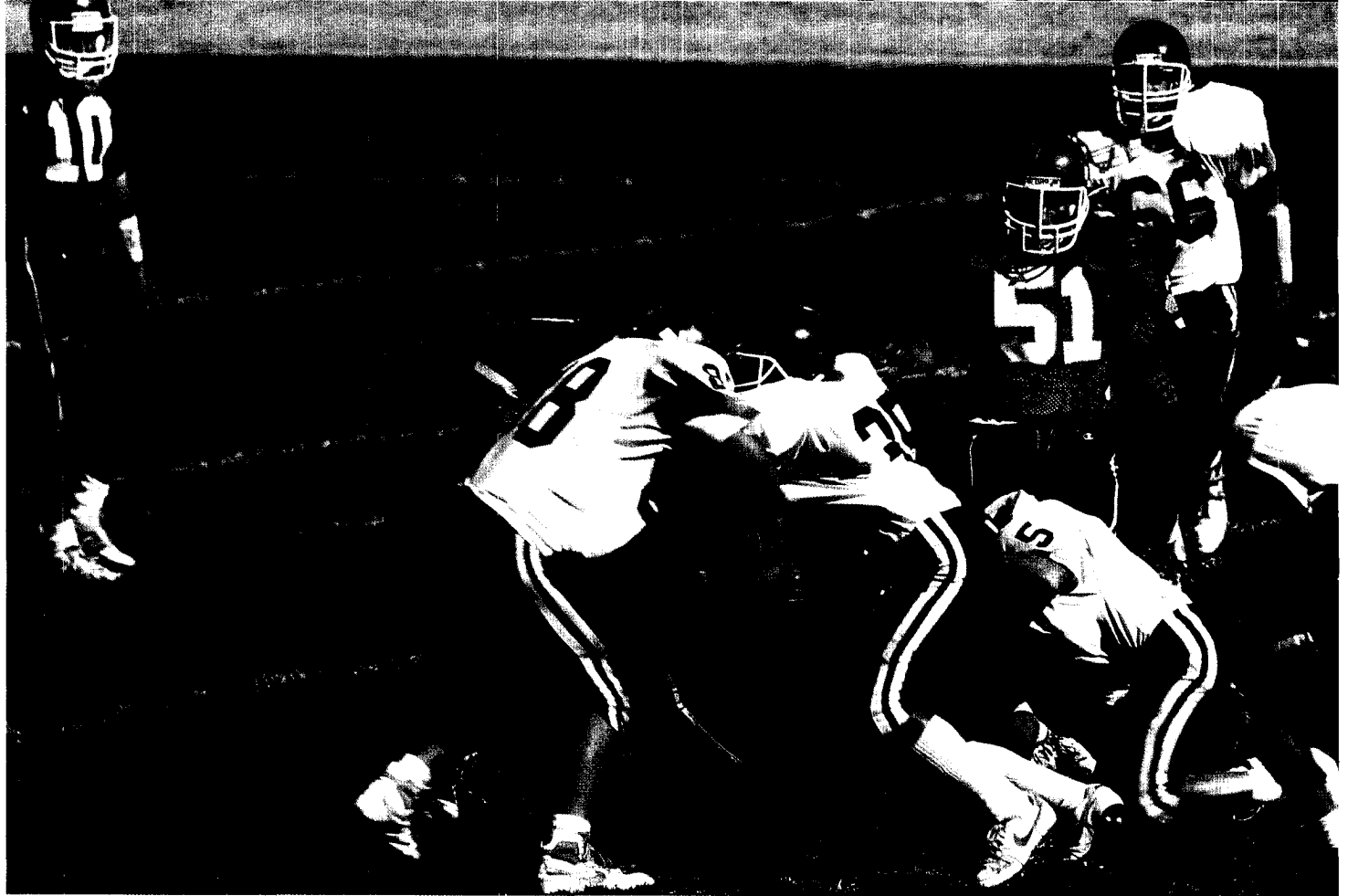


External Peripheral Equipment

The portable laptop computers cannot be isolated from OA equipment in the office. From the printers, to the Ethernet adapters which enable online data transfer by connecting them with LANs, or external FDDs which transfer data from conventional 5-inch FDDs, the variety of peripheral equipment is expanding to fulfill the needs.

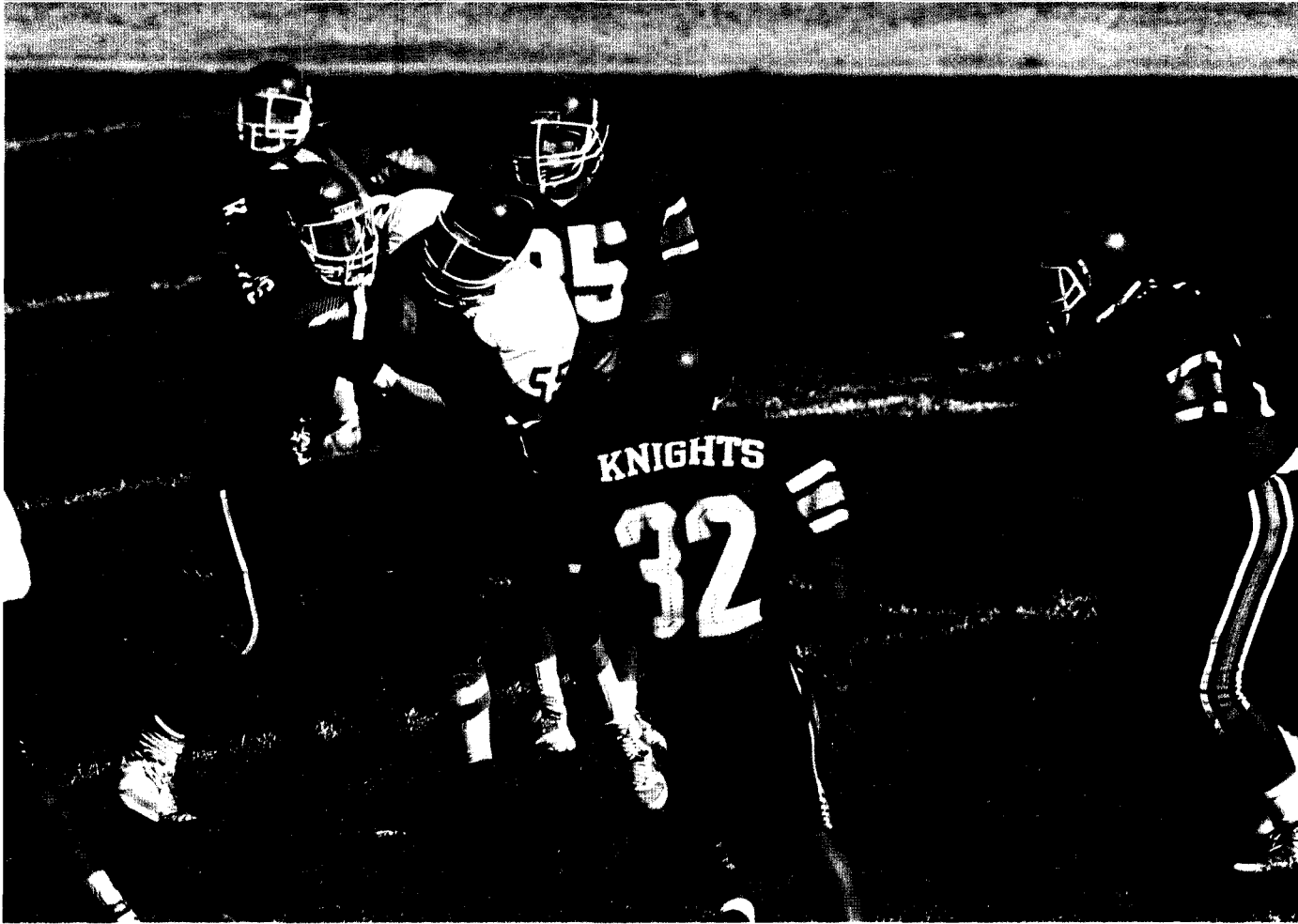


TEAMWOODRIDGE





People with different talents and widely varied personalities working together, each individual's contribution complementing and assisting the work of others. It is by such teamwork that societies are created and grow strong. In an information-oriented society, peripheral equipment such as PCs and word processors, disk units and printers with their high reliability and sophisticated capabilities are indispensable to the support of teamwork. Toshiba semiconductors are key components of these devices, fostering teamwork at another level — that between man and machine.



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